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Heat Treatment of Carbon and High-Speed Steel Tools

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Determining factors in the development of metal-cutting tools—Heat treatment for carbon-steel tools—Compositions and heat treatment for high-speed steel tools

IN THE designing of machine cutting tools there are three important considerations governed by the type of cutting to be done. These are the shape of the tool, the material in the tool, and the heat treatment of the tool. This article will cover the materials used in tools and their various heat treatments. The shapes of tools are too numerous to be covered here, and vary widely depending upon the work to be done.

Cutting is chiefly a shearing action, combined with considerable bending stresses due to the taper of the tool. The initial cut or start of the tool is the most difficult phase of the operation, since the concentration of force in the area of the cutting edge must be very high in order to double-shear and compress the material being cut. The cutting then proceeds more advantageously due to the tool taper, but with the additional resistance due to friction. Heat generated by the severing of the atomic bonds, plastic flow, and somewhat by the solid friction, is dissipated by conduction through the mass of the tool, adjacent parts of the machine, and, very often, by a stream of circulating water.

Tool Temperature Measures Cutting Resistance

It has been found that the temperature of the localized heated section, that is, the cutting edge of the tool, is a good measure of the resistance to cutting offered by a material. In the case of metals, this resistance is a function of the Brinell hardness, strength, and ductility and also of the freeness of cutting. Thus in carbon-steel tools, we develop by proper heat treatment a hard martensitic structure which, up to the advent of greater production and the tougher alloy steels, has been found satisfactory for all classes of work. With increased production and alloy steels the cutting edge temperature was found to be sufficiently high to draw the temper of a carbon-steel tool to a point where it was incapable of cutting any further.

This does not mean however that carbon-steel tools are out of date; on the contrary, they are used more extensively, but only when the cost of production is not increased over that when high-speed tools are used. The latter type of tools are of great variety as regards chemical composition and represent a development in tool design that is solely responsible for our great automotive production in which alloy steels have been freely used. High-speed steel tools differ from those made of ordinary carbon steel in their ability to maintain a sharp, strong cutting edge, when heated in use to a temperature which would destroy the cutting edge of the carbon-steel tools.

Heat Treatment of Carbon-Steel Tools

In order to have logical arrangement, let us first consider the heat treatment of ordinary carbon-steel tools. For a given heat treatment the hardness of steel increases with the carbon content which, for tools, varies from 0.65 to 1.50 per cent, depending upon the type of tool. Most of the machine cutting tools have a carbon content of about 1.0 per cent, although this is not a hard and fast rule. Heat treatment of steel, as commonly understood, consists of the operations of normalizing, hardening and tempering, but, in order to make the subject complete, we might also consider forging temperatures.

The forging for all percentages of carbon is done at red heat or at a temperature varying from 1,520 deg. F., for 1.50 per cent carbon, to 1,560 deg. F. for 0.65 per cent carbon. Tool steels should not be forged at a lower temperature than about 1,050 deg. F., as this produces forging strains which normalizing cannot eliminate. It is very important that this part of tool manufacture should be properly performed, since the quality of the steel and, consequently, the endurance or life of the tool greatly depend upon the homogeneity and uniformity produced during forging. Very often during this operation the heating is not uniform, the temperature is too low, or the power hammer is too light—all of which combine in producing a poor material in the tool that no amount of correct heat treatment will cure. Poor forging sometimes causes cracking or bursting of the tools during the hardening operation.

The forged tools should be normalized before hardening to obtain a uniform and refined grain structure and to give the hardening operator a datum plane upon

which he may base his procedure in obtaining the desired structure. To normalize a steel tool it must be heated uniformly to a temperature above the upper critical point which, for carbon tool steels, averages about 1,330 deg. F. It must be held at this temperature long enough to permit complete penetration of heat and refinement of grain structure. The total heating and soaking time is determined by the maximum section and the weight, varying in usual practice from one to five hours.

The temperature employed in normalizing must be sufficiently in excess of the critical range to just about produce grain refinement and relieve internal forging strains, but, if the temperature is too high, austenitic grain growth and breaking down of the intercrystalline bonds takes place. In practice it has been found that a small increment of temperature above the critical range is also necessary to penetrate the scale on the tool. On the other hand, too low a normalizing temperature, particularly for the higher carbon contents, fails to break up the massive cementite, resulting in a brittle structure. Thus, the best normalizing temperatures for ordinary carbon tool steels varies from 1,475 deg. F., for 0.65 per cent carbon, to 1,700 deg. F. for 1.50 per cent carbon. After a sufficient length of time in soaking the tool is removed from the furnace with preheated gripping tongs and allowed to cool freely in air with the maximum area exposed.

Before proceeding with the hardening of the tool a certain amount of grinding on a wet sandstone is necessary, in order to remove black scale and decarbonized surface material. When more rapid grinding is desired an emery or carborundum wheel may be used, but in this case no water should be used or local hardening will otherwise take place. This will give trouble during the hardening operation.

Heat Treatment for Hardening

The hardening operation may be divided into two parts, namely, heating and quenching. In heating, the tool is placed in a gas- or oil-fired furnace under pyrometric control, so that the proper temperatures for the carbon content of the tool will not be exceeded. The heating should be done slowly and uniformly in such a way that, when the tool is about to be quenched, all parts of it, particularly the sharp edges and corners, will be at the proper temperature. On the other hand the soaking period should not be too long for surface decarbonization will otherwise take place, producing hard and soft spots and a generally unsatisfactory tool. Exceeding the proper temperature produces grain growth and, in the severe case, causes the formation of oxides in the steel, that is, the steel is "burnt." If the tool is heated too quickly severe internal strains are caused, due to the uneven expansion and contraction. The proper temperatures for hardening vary from 1,550 deg. F., for 0.65 per cent carbon, to 1,350 deg. F. for 1.50 per cent carbon.

After it has been uniformly heated throughout to the proper temperature the tool is removed from the furnace and plunged into a tank of water or oil, usually water. The quenching tank should be placed as near as possible to the furnace and provided with a system of piping for circulation of the quenching fluid. It is also important to have the quantity of the quenching fluid sufficiently large to take care of the size of the tool being hardened. When it has reached a temperature of about 230 deg. F., the tool is removed.

The reasons for steel being hardened when quenched from temperatures just above the critical range are well known, but it might be well to briefly outline them again. When steel is at a temperature above the critical point, it is in an austenitic condition and, if cooled from this state slowly in air, the plasticity of the steel permits a series of transformations in structure until the stable pearlitic state is reached. If instead of cooling slowly, the steel is quenched in water the mass is made so rigid that molecular transformation is arrested and a structure called martensite is produced which is extremely hard and unsuitable for most machine cutting tools. Lengthening the time of the temperature decrement by quenching in oil or slower medium results in a troostitic structure which is softer. Practically a combination of the martensite, troostite, and possibly austenite, is produced.

For most classes of work the martensitic structure in a tool is too brittle so the rigidity of the metal is decreased by heating to a temperature below the critical point, thus permitting the steel to make the transformation corresponding to that temperature which it would make if quenched in oil. This type of tempering relieves strains besides removing brittleness, and is done at a temperature ranging from 400 to 500 deg. F., depending upon the degree of hardness required in the tool. For just relieving the strains and maintaining the hard martensitic structure a temperature from 350 to 375 deg. F. is usually employed, while for both relieving strain and toughening, a temperature of from 500 to 600 deg. F. is used. The same precautions necessary in the quenching for hardening are also important for quenching in tempering. Lathe tools, milling cutters, etc., for cutting copper alloys are tempered at 360 deg. F.; drills, milling cutters, taps, etc., at from 450 to 500 deg. F.; press dies, flat drills, drop dies, reamers, etc., are tempered at 550 deg. F.

As pointed out previously, the introduction of high-speed steel about 30 years ago has resulted in greatly increased production due to a more rapid cutting speed, a heavier cut and feed, and greater durability of the tool made from this steel at the elevated temperatures. They are different from carbon-steel tools, however, in that they are generally stiffer and have cutting angles which are not as sharp. The cutting speeds for high-speed tools can be increased to a maximum of 27 ft. per min. on heavy cuts in hard alloy steels, and 75 ft. per min. on light cuts in the same steels, without too frequent regrinding. Changes of tool angles and cutting speed affect the special high-speed steel tools more than the ordinary carbon-steel tools.

The chief elements in modern high-speed steels are chromium, tungsten and vanadium. Steels containing one or more special elements, such as molybdenum or uranium, are called "special" high-speed steels. The entire series of these steels may be classified as follows:

A—Low tungsten.
B—Medium tungsten.
C—High tungsten-low vanadium.
D—Cobalt.
E—"Special."
1—Molybdenum.
2—Cobalt-molybdenum.
3—Uranium.

The average compositions of these steels run somewhat as follows, the values being taken from a paper

by French and Strauss published in the *Journal* of the American Society for Steel Treating:

Steel	A	B	C	D	E-1	E-2	E-3
Carbon	0.65	0.66	0.66	0.69	0.64	0.65	0.66
Chromium	3.69	3.93	3.54	3.70	3.65	4.25	3.63
Tungsten	13.07	14.92	17.90	16.38	15.00	17.70	17.03
Vanadium	1.47	1.54	0.88	1.21	1.60	1.00	1.36
Cobalt	....	....	....	3.28	....	4.88	....
Molybdenum	....	....	....	....	0.71	1.07	....
Uranium	....	....	....	....	....	....	0.25

The following elements are present in all these steels in the average proportions shown:

	PER CENT
Manganese,	0.26
Phosphorus,	0.023
Sulphur,	0.027
Silicon,	0.27

About fifty variations of these steels are on the market under different trade names, although about 50 per cent of them are of the high-tungsten (C) type. In performance tests on a 3 per cent nickel steel, type A and type D high-speed steels were found to be superior to type C or type E. The power consumption was found to be the same for all steels, while changes of tool angles and cutting speeds affected the special steels more than the others.

The heat treatment of high-speed steels is surprisingly uniform, notwithstanding their great variation in composition. Procedure in the heat treatment of these steels may be considered on an average basis as follows:

1—Forging.
2—Annealing.
3—Hardening.
  a—First preheating.
  b—Second preheating.
  c—Hardening heat.
  d—Quenching.
4—Tempering.

Forging—Heat the steel very slowly to about 1,785 deg. F., at which temperature the tool may be forged by hand or power hammer. The forging should be carefully performed in order to prevent internal straining and, in particular, no work should be done at a temperature below 1,560 deg. F. The precautions given in regard to carbon tool steel apply likewise to high-speed steels.

Annealing—In order to give the hardener a basis for his procedure, the steel is annealed by slowly and uniformly heating it to a temperature of 1,600 deg. F. and it is held at that temperature long enough to obtain complete grain refinement. The length of time for heating and soaking depends upon the shape, size and weight of the tool being annealed. The tool is then allowed to cool in the furnace, or in some infusorial medium which will permit uniform slow cooling. It will be noted that the steel in this case is not cooled freely in air as in the case of carbon steel tools, because if so done the steel would be hardened. This property of air-hardening, as it is called, will be explained below.

Hardening—The hardening of high-speed steels takes place at a much higher temperature than in the case of ordinary carbon steels, but this is not due to any direct lowering of the critical point. The chromium and tungsten carbides that are formed are dissolved at a sufficiently high temperature and, if the cooling is sufficiently rapid, they are retained in solution, the resulting structure being martensitic. In order to cause complete absorption of the carbides, however, a very high temperature which very nearly approaches the melting point of the steel is required, while cooling freely in air is sufficiently rapid to prevent the carbides reforming. The martensitic structure thus formed is relatively so stable and of such superior cutting quality that the tool cutting edge may be heated to a red heat (1,100 deg. F.) while cutting before the martensitic structure is affected.

Critical Points Influenced by Alloys

These remarkable properties of greater stability and better quality of martensite than that produced by quench-hardening ordinary high carbon steel is due to the well-known indirect influence of the elements chromium and tungsten on the critical points. The presence of these elements causes the critical point on cooling to be lowered as the temperature from which cooling begins increases. Thus, if high-speed steel is quenched from a temperature as high as 2,350 deg. F., or very near its melting point, the critical point will be so low, about 1,000 deg. F., that the stiffness of the metal will hold the martensitic structure in a more stable condition. For this reason the steel would have to be heated to a very much higher temperature before being tempered and thus losing its cutting ability.

First Preheating—In order to prevent decarbonization due to scaling of the steel at 1,200 deg. F., the bulk of the uniform heating is done in a furnace at 1,100 deg. F.

Second Preheating—The steel tool is removed from furnace No. 1 and placed in furnace No. 2 long enough to raise the temperature of the tool to about 1,500 deg. F.

Hardening Heat—Finally, the steel tool is transferred to the hardening furnace No. 3, maintained at a temperature of about 2,350 deg. F. Tools with thin sections are heated to a slightly lower temperature, in order not to burn them. In no case should high-speed tools be held at the higher heat longer than necessary, or excessive grain growth and brittleness will result.

Quenching—The tools are now quenched in air or oil at a temperature of about 200 deg. F. from the hardening furnace. All the precautions as regards the design of the quenching tank and the quantity of the quenching medium given in the case of ordinary carbon-steel tools are also necessary for high-speed steel tools.

Tempering—Drawing to 1,100 deg. F. in an open furnace, or in a salt or lead bath, for a sufficient length of time and cooling in air or oil has been found to produce the best results in most cases. Treatment of this kind produces a small amount of troostite with its corresponding softness. No drawing at all results in a polyhedral structure of austenite with only a few undesolved carbides and tungstides.

After hardening the tools are ground lightly to shape, care being taken not to draw the temper of the cutting edge.

In conclusion particular attention is called to the statement that "the temperature of the localized heating in the cutting edge of the tool is a good measure of the cutting resistance of the metal." If this be strictly true, then the great tendency for developing metals of great toughness and hardness for certain industrial purposes, as for example, some high-nickel chrome steels, should be carefully controlled, since in this case even the high-speed tools might be limited in their output.

Automatic Centrifugal Clutches

By Hubert Bentley
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THE automatic centrifugal clutch is designed primarily to overcome the difficulties associated with the starting and acceleration of an electric motor, when the machine or machines to be driven require a large starting torque. A further valuable feature is found in the fact that the clutch will slip if the motor is overloaded, thus providing a very effective safety device. No special switch gear is necessary to overcome a large starting torque, and the minimum of current is absorbed when starting. Its application is by no means limited to the electric motor drive, since it is also effectively employed to insure easy starting of gas and oil engines used for driving.

The alternating-current motor of the squirrel-cage type is not only the simplest and cheapest, but also the most robust type of motor constructed. It has normally a low starting torque and, for this reason, lends itself admirably to the application of the automatic centrifugal clutch. Hitherto, owing to its poor starting torque, the use of this type of motor has been greatly restricted, but the centrifugal clutch now provides the remedy. As soon as the current is switched on to the motor, the clutch comes into operation and the motor is allowed to accelerate to a pre-determined speed without load. Then without shock, either to the motor or the machine being driven, the clutch gradually takes up the load. The clutches may be with equal effectiveness applied to either large or small motors, and used for the driving of individual machines or lineshafts. They can be employed for transmitting from ¼ to 2,000 hp. at speeds not below 250 to 300 revolutions per minute. The high speed is necessary for proper centrifugal action.

Design of Centrifugal Clutch

While there is a variety of centrifugal clutches on the market, the principle governing their design is the same. In one type, the clutch is composed of two main parts, an exterior rim and an interior spider. The spider is keyed to the motor spindle and carries a number of loose shoes in suitable pockets. The outer faces of these shoes are covered with an inexpensive friction fabric, and when necessary the shoes themselves can be replaced in a few minutes at a small cost. As the motor increases its speed, the shoes are thrown radially outwards by an increasing centrifugal force and contact with the interior of the pulley rim, thus gradually increasing its speed until full speed is reached. The drive then becomes positive, the weights of the shoes being so regulated that the power transmitted by the shoes equals the power of the motor when the motor is running at its rated speed, and all slip ceases. When these clutches are applied to single-phase motors with a low starting torque, the shoes are controlled by springs that prevent engagement until the motor has attained any predetermined speed up to 80 per cent of the full speed. These springs may be easily adjusted by means of set screws, either to counteract the wear on the friction lining of the shoe or for adjusting the time of engagement. In normal cases, for the direct-current motor and for two- and three-phase motors, the shoes do not need to be spring controlled and engagement takes place gradually. With a 10-hp. motor, only 1½ hp. will be transmitted with the clutch running at half speed.

In another type of centrifugal clutch, a cast-iron body is keyed to the motor spindle and provided with machined slides to receive slippers, and fulcrum pins to carry trip levers. The slippers are machined to suit the slides in the body and are shod with asbestos friction linings. They are fitted with pins which carry rollers. The trip levers are cam-shaped to bear against the rollers and hold the slippers away from the friction rim. The levers are held in position by springs, the tension of which may be adjusted by means of the adjusting bolts.

Effects

When the motor has reached a certain speed, the centrifugal force of the levers overcomes the tension of the springs, causing the levers to open outwards. The slippers are released and move outward against the friction rim, automatically picking up the load. When the current is cut off, the levers gradually recede to their former position and withdraw the slippers from contact with the friction rim. These clutches are designed to engage at 75 per cent of the normal speed, but the spring adjusting bolts allow the slippers to come into operation at any desired point between 50 and 90 per cent of the normal speed. Full advantage is taken of the weight of the slippers for the required frictional contact, thus enabling the various parts to be made as light as possible and reducing the time of rubbing of the friction surfaces to a minimum. To prolong the life of the friction lining the surfaces should be kept moist with oil or water, a procedure that assists greatly in the proper action and durability of the mechanism.

In the cotton mill and the textile factory, the centrifugal clutch is frequently interposed in the line shaft drive, operating through the medium of belting, ropes, or the various forms of gearing. When looms are individually driven the centrifugal clutch ensures a very satisfactory drive besides protecting both the motor and the loom from damage. It is also applied to ring spinning frames, which cannot be started too suddenly without a consequent breaking down of the yarn or the production of an uneven texture. When the rope drive is in use, the clutch is arranged between the motor and the rope pulley. In like manner, centrifugal machinery generally presents considerable difficulty in starting and acceleration, and in this class of machinery the centrifugal clutch may be applied with considerable success.

The Gear-Driven Loom Motor

The modern gear-driven loom motor equipment is mounted directly on the loom frame instead of in a separate cabinet on the floor, and it embodies the automatic centrifugal clutch. In this equipment instead of the shock being absorbed by the driven wheel on the loom shaft, it is absorbed by the high-speed motor pinion. The pinion and centrifugal clutch are designed to give no slip during the normal running of the loom, to provide necessary slippage at the moment of sudden stoppage to take the shock off the teeth of the spur wheel. They also allow a small time lag at starting to allow the motor to attain a pre-determined speed before engaging the spur gears and, incidentally, to ease the shock on the teeth and also the ball bearings of the motor.

Kinks From a Texas Railway Shop

By Howard Campbell
Western Editor, *American Machinist*

Southern Pacific shops at San Antonio have number of emergency tools—Testing super-heater units—Reclaiming bushings to make smaller ones—Some handy bench tools

THERE is no shop but, from time to time, develops special tools and methods to fit its particular needs and facilities. The Southern Pacific shops at San Antonio, Texas, are no exception, a number of tools having been developed there that are worthy of notice. Among them is a set of chuck-jaws designed to hold tires on a wheel lathe, shown in Fig. 1. The jaw teeth are cut in a radial piece that is pinned through the center to the jaw and through the lower end to a 1½-in. 6-thd. screw, which can be seen in the illustration. The screw protrudes from the chuck-jaw body at each end sufficiently to allow for a nut. By turning the nuts with a wrench, the screw is fed in the desired direction to tighten or release the jaw. The strength of the mechanism is evident from the fact that a cut ⅝ in. wide and ½ in. deep can be taken without difficulty.

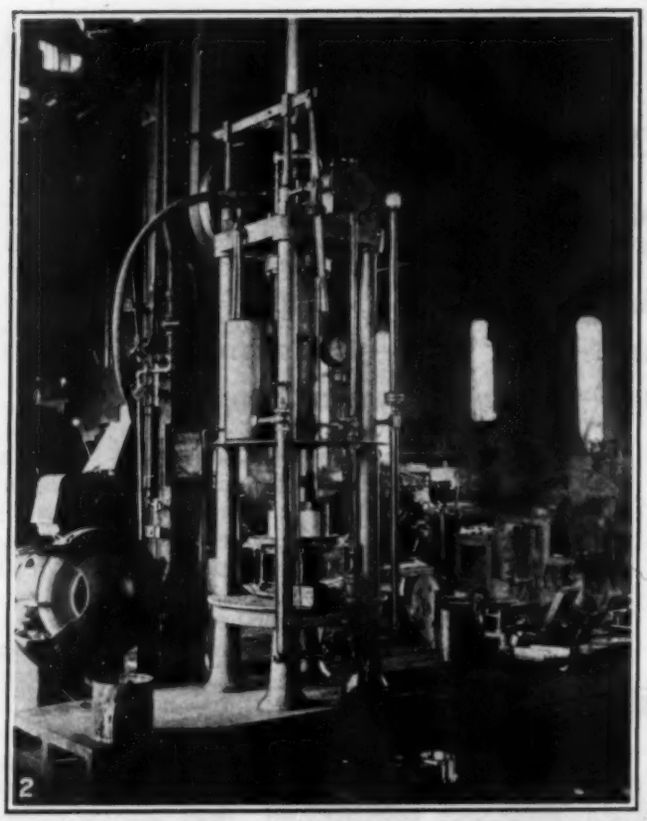
Fig. 1—Tire chuck-jaws for wheel lathe

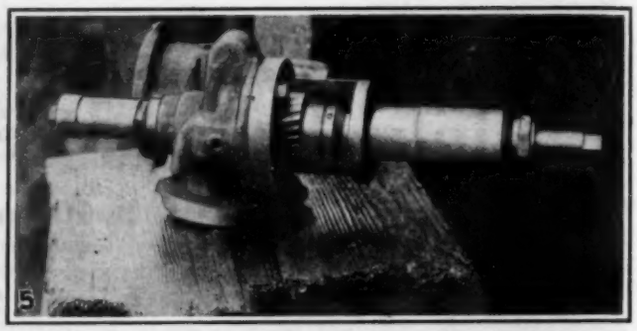
The hydraulic rod press illustrated in Fig. 2 was made from pieces that were gathered around the shop. The base is made from a steel tender wheel, and the supports are jack-shoes. The machine is bound together with four 2-in. rods that extend up through the block on which the machine stands, through the supports, base, and through the pipes that serve as the frame and are anchored with nuts at both ends. The cylinder is attached vertically to the top plate and extends downward through the center of the machine. Water is pumped into the cylinder from a pump on the top of the press, and which is operated by a 2½-in. belt on a 30-in. pulley. The stroke of the pump rod is 4 in. and a maximum pressure of 1,000 tons can be built up. Means for raising the piston are furnished by an air cylinder attached vertically to the top plate of the press, and to which the piston is attached. The press is easily operated and is both fast and efficient.

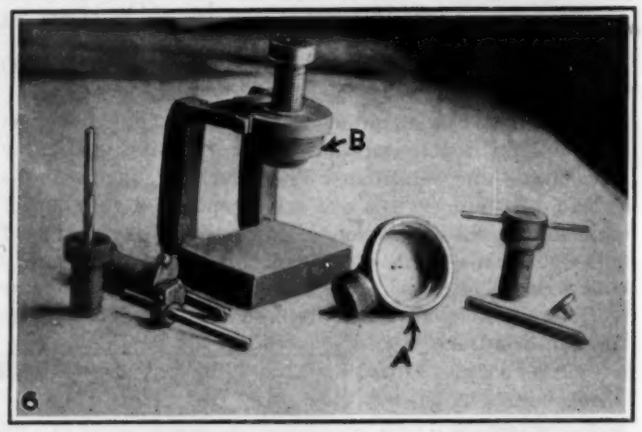
It occasionally becomes necessary to form a leaf for a spring, which is done as shown in Fig. 3. The leaf is heated to the necessary temperature, then it is aligned behind a cold section of the same size so that it will be properly formed and is sprung to the desired curvature. The piece is braced against two adjustable blocks on a ¾x6-in. steel section that is bolted to the rear edge of a large face-plate, as shown, and pressure is applied by means of a handwheel on a 1¼-in. 2-P square-thread screw. After forming, the spring is tempered in an oil bath.

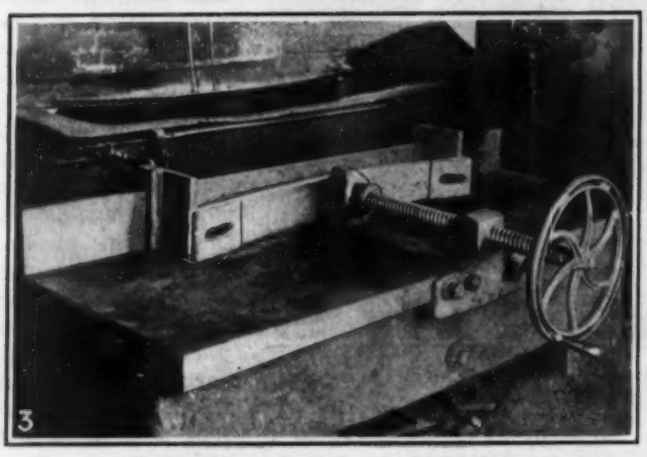
Three equalizing piston-chamber bushings can be made from one New York brake valve-chamber bushing, using the set of tools shown in Fig. 4. The tool *A*, which is hollow at the rear end and has a taper shank that can be slipped into a lathe spindle, is placed in position in the lathe, then the valve-chamber bushing *B* is inserted into the open end of the tool and a bull-center is applied against the end of the bushing with just enough pressure to hold the piece from turning so that it can be cut with a parting tool, after which a notch is filed in it by hand, as shown at *C*. The bushing is then inserted into the base of the sensitive drill press *D* and the ⅞-in. hole is drilled for the feed groove. The drill press is a unique affair, both column and drill bushing being adjustable and the spindle being made integral with a turbine that is driven from the shop air-line. After the hole is drilled, the piece is bored in the tool *A* the plate *E* being first inserted so that the boring tool will have the necessary clearance at the rear end of the piece. The collar *F* is screwed onto the tool to lock the bushing in place. The bushing is bored to within 0.010 in. of the finish size, then is reamed.

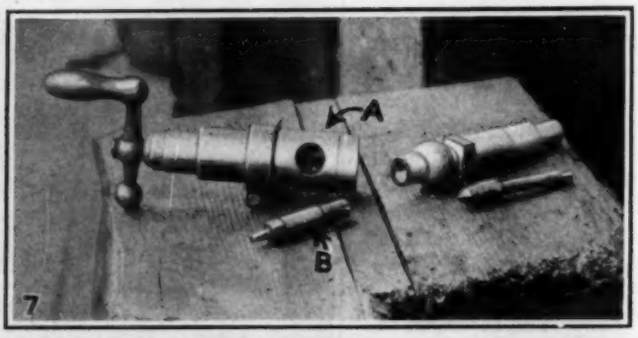
A tool for facing off the ends of Nathan reversible boiler checks is shown in Fig. 5, in place for operation. The cutter-spindle extends through a housing that forms part of the frame, which is bolted to the piece as shown. The opposite end of the spindle passes through a bearing and is anchored to a cap that allows it to turn in the bearing without binding. An adjusting nut, that is threaded onto the bearing, faces against the end of the piece and provides means for adjustment so that the desired amount of pressure on the tool can be obtained. The spindle is turned by a wrench.

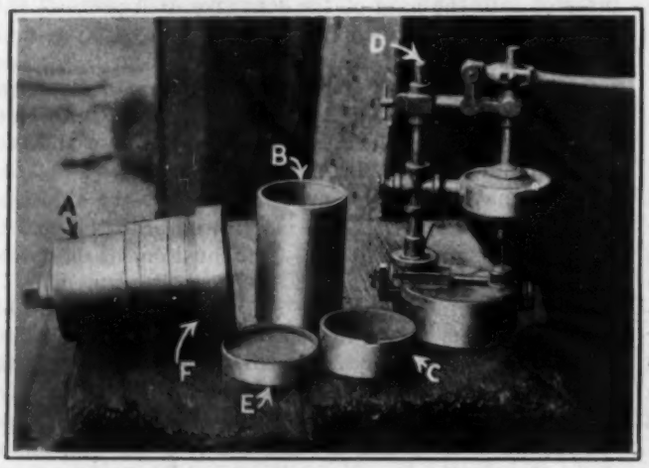












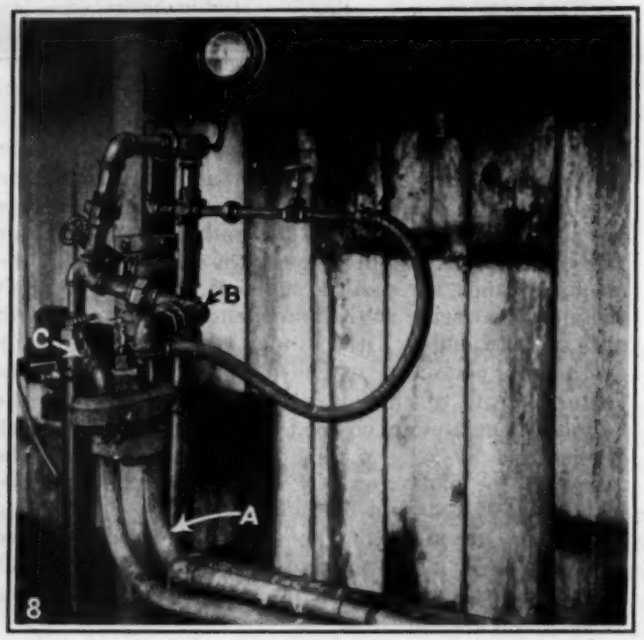


Fig. 2—Home-made hydraulic press. Fig. 3—Forming a spring leaf. Fig. 4—Tools for making equalizing piston-chamber bushings. Fig. 5—Facing end of Nathan reversible boiler check. Fig. 6—Tools for reclaiming pump-governor pin-valve ports. Fig. 7—Tools for seating gage cocks and stems. Fig. 8—Testing superheater unit

Pump governors in which the pin-valve ports have become too badly worn for further use are reclaimed by the use of the tools shown in Fig. 6. The valve, shown at *A*, is screwed onto the fixture at *B* then the port-hole is drilled with a ¼-in. drill to a depth of 7/16 in. and is reamed to the same depth with a 7/16-in. reamer, followed with a ⅜-in. reamer to a depth of ⅛ in. A bushing 7/16 in. long, 7/16 in. in dia., and with a ⅛-in. collar, ⅜ in. in dia., and with a hole of the required size is made and pressed into the hole in the valve. If the bushing protrudes, it is faced off with the ⅜-in. reamer. The taper reamer is used to break the corner of the hole, forming the seat.

A tool for reaming and seating gage-cocks and forming the gage-cock stems is shown in Fig. 7. The gage-cock is screwed into the body of the tool *A*, tool *B* being attached to the ball-handle to form the seat in the end of the gage-cock. The gage-cock is then removed and the gage-cock stem is screwed into the tool so that it can be formed to fit the seat in the cock, which is done with the aid of the tool shown in position in the illustration.

An outfit for testing superheater units is shown in Fig. 8. The unit is shown at *A*, clamped on one side to the pipe *B* which is attached to the water supply and on the other side to the pipe *C*, which is attached to the shop air-line. Water is pumped into the unit until the gage shows 650 lb. pressure, then the water is shut off and the drain and air valves are opened and the water is blown out.

Wanted—A Yard-Stick to Measure Men

By John R. Godfrey

TOM JOHNSON called me up the other day with, "Uncle John, can I come up to your house some evening soon, I've got a lot of things to talk over with you. No—Dad isn't in on this, I want to see you all by my lonesome for a change. Tonight—fine, I'll be up early," and he hung up. Of course Tom isn't a nephew, but I'm getting to the point where a lot of young folks call me "Uncle"—and I rather like it.

I was a bit curious to know what Tom had on his mind, especially as his Dad wasn't in on it, so I was glad he could get it out of his system soon—I wanted to hear what it was all about. And it was about as interesting an evening as I've had for a blue moon, besides showing that all the brains are not going to pass out with the present generation.

"Uncle John," he began, "I just had to talk to someone, and I know you'll understand that I'm not swelled up with the idea that I've got a new brand of brains or know so much more than Dad. But coming into the business fresh from the outside, I think I can see some things that he doesn't—or that I wouldn't if I'd been in it all my life. It's about wages, Uncle John, and I want you to help me get things straight in my own mind. It's only recently that I've been studying this side of the business—production methods seemed all important before—and I'm wondering if the wage and personnel end hasn't a lot to do with production too.

"Now don't think I've got my notion that we ought to raise wages—or lower them—indiscriminately. That's the trouble, it seems to me. When I look over the payroll and try to make wages tally up with general ability, length of service and real worth to the Johnson Motor Co. I get a sort of woozy feeling. I'm almost ashamed to go out into the shop where some of our old timers have been working their heads off for years to the glorification of our dividends. No, I haven't been studying Marx lately or joined the Socialist party—and I know we've got to have dividends. So just listen while I tell you a few things I've discovered.

"Take the case of Sam Duncan—you know him. Sam has been with the company for over 20 years. He knows more about the Johnson Motor than anyone in the place. He can handle any job that comes along and keeps us out of many a hole. He's one of these pinch hitters that baseball teams pay thousands of dollars to get, he's always dependable, and never has a grandmother's funeral to go to just when you need him most. Sam isn't much of an executive and probably wouldn't shine as a general foreman. He's so darned honest himself he lets people put things over on him.

"But with all Sam's virtues and worth to us he's getting less money than young Thompson who runs that new crankshaft grinder. Thompson's a good man but he'd quit us cold tomorrow for a little more money anywhere else. He isn't dependable if there's a big ball game in the offing, and his machine needs lots of looking after. He is on piece work and turns out a lot of crankshafts—good ones, too. But if all our men were of the Thompson type we'd be in a hole. It takes the Sam Duncan's to keep the shop running.

"Now, Uncle John, how are we going to play fair with Sam, and the rest?

"Then there's Dick Walton—nice chap with lots of ideas—most of which don't work. But Dick has a college M.E.—has a good line of talk and sold himself to Dad for about double what he's worth to us—if we take Sam Duncan as a standard. I don't know whether Sam knows what Dick gets or not, but I'll bet he does. Such things get around no matter how much you think it's a dead secret and Sam can't help feeling that he's had a raw deal. Yet in spite of it he plugs along, giving us his best—and I'm almost ashamed to look him in the face.

"The office isn't free from this sort of thing either. You know little Miss Hay whose been Dad's right hand "man" in the office for years. Knows more details of the business than Dad himself. But she came to work when fifteen a week was good money and so Dad thinks she ought to be tickled pink with twenty-five now. But Sales Manager Jones pays his girl thirty-five because he tacks on the title of secretary and Dad stands for it.

"Here Mary Hay has given fifteen of the best years of her life to the Johnson Motor Co., and because she grew up with it Dad sort of thinks she belongs—and doesn't realize that he's really cheating her out of what actually belongs to her. If she'd told Dad five years ago that she either had to have more money or quit, she'd have got it. But because she is quiet and not assertive she jogs on at the old rate.

"That's one thing I can fix however. Dad's going away on a long trip next month and leaves me in charge and Mary Hay is going to be my *secretary* at forty per. I presume Dad'll have a fit when he finds it out but it's

only her due. And I'd be plumb lost in the office without her knowledge of the business. I wouldn't mind a bit if she was younger and better looking. But she isn't to blame for either. She knows the business and she's going to get something near what she's worth when Dad goes away.

"But it isn't all the question of wages. It's the idea of not being fairly dealt with. When you see some one come into a plant without experience and get more money than an old timer just because he has the nerve to demand it, there's a sense of unfairness that gets under your skin.

"Sam Duncan couldn't grind as many crankshafts a day as young Thompson—and if that was Duncan's job there'd be no question as to who should get the most money. But Sam's work is too varied to put on piece work, if we wanted to. And there's no question as to his being valuable. Still the payroll says he's a dub as compared with Thompson.

"There's more than the actual number of pieces per day which count in determining a man's worth. When Thompson lays off a day as he does frequently, we lose the production from a machine which costs a bunch of money. It also upsets the schedule and may cost more than his wages in that way. He's no earthly use on any other machine in the shop and can't help out anywhere else in a pinch.

"There are things which you can't pay by piece work. I mean dependability. Not only willingness but ability to help out whenever necessary, and the knowledge that comes only from long experience on any given product.

"We talk a lot about loyalty, Uncle John, but we seem to think it's all one-sided. The mystery to me is how men and women like Sam Duncan and Mary Hay remain loyal when they've had such a rotten deal. Real loyalty isn't one sided and I'm going to try and find a way to show our side of it.

How Wages Are Determined

"The real trouble seems to be that we haven't got beyond the horse trading game when it comes to paying wages. We jockey around to save a few dollars a week and give the highest wages to the best bluffers who come along. We've got to find some way to measure a man's real worth to us and pay him accordingly. We ought to keep tabs on his work so as to raise him before he asks—if he's worth it. We need some yardstick that will measure the value of real loyalty—not the kind that says 'yes' to everything we propose—and also to dependability.

"We've got to have some sort of measure beside the 'say-so' of the foreman or even the big boss. There are personal opinions which may vary from things entirely apart from the man's value to the shop. If the man's politics differ from those of the foreman, or he goes to another church, or makes eyes at the same girl, the foreman's judgment is warped and not fair to either the man or to us.

"We want some sort of continuous record and not just what the foreman happens to remember last.

"We've lost a lot of good men because we waited for them to kick for a raise. Somebody else knew what they were worth better than we did and picked them out from under our noses after we'd spent good money training 'em. And I don't blame them a bit, or say they were any more disloyal to us than we were to them. Then, too, we've raised men who could blow their own horns and kicked good and plenty, when we'd have been better off to let 'em go. And all because we don't have any measure of value, but try to kid ourselves into believing we are judges of men. We're all a bunch of bluffers for the most part and we bluff ourselves as much as the other fellow.

"Guess I've talked a blue streak, Uncle John, but I had to get it off my chest or bust. Think it over—hard—and let me know how I can help things even a little,"—and he was gone before I'd hardly realized it.

Tom is thinking a bit at any rate and he has the sand to try and be honest with himself too.

Welding High-Speed Steel

By S. W. Miller
Union Carbide & Carbon Research Laboratories

In any fusion welding process the metal must be melted and when it solidifies it reverts to the cast condition. High-speed steel is an alloy containing about 0.70 per cent carbon, 7 per cent chromium, 17 per cent tungsten, 0.40 per cent manganese, about 0.25 per cent vanadium being sometimes added. It should be understood that the amounts of these elements vary widely in different high-speed steels, and that it is therefore not possible to produce one welding rod that will answer all cases, and also that as some of the elements are reduced in amount by the melting and as the amounts lost are indeterminate, it is probably not possible to obtain anything like the same chemical composition in the added metal as in the base metal.

High-speed steel, in the cast condition, is very brittle, and a large part of it consists structurally of carbides of probably all the elements in the alloy. These carbides exist in large masses and cause brittleness.

Before high-speed steel can have any value for cutting metals, these carbides must be dissolved, at least to a very large extent, in the iron, and must be held in this condition by rapid cooling. The solution of these carbides, in the case of a casting, requires a high temperature for a long time, much longer than is necessary in the case of a forging.

It might be possible in the case of a minor defect, or where the tool is not pushed to the limit, to make a weld that would answer the purpose, but there is good reason to believe that the weld would fail under severe service before the rest of the tool.

The principal difficulty, however, is that it is practically impossible to make a weld in any high-speed steel that will not crack next to the weld, either while cooling off or when it is put in service. As stated before, the cast metal is brittle due to the presence of free carbides, and during the cooling down these carbides, which are themselves brittle, create zones of brittleness throughout the cast weld and in the melted zone of the base metal.

Therefore, if it is desired to try welding of high-speed steel, small strips of the material should be used for welding rod; the weld should be made as quickly as possible; the piece should be preheated to a bright red and cooled slowly, after which such heat-treatment should be applied as may be necessary to get the carbides into solution and hold them there.

Different results may be expected with different alloys, but I have no confidence whatever that a weld can be made in high-speed steel that would be the equal of the forged material, although in some cases the result may be good enough.

Journal of the American Welding Society, Vol. 3, No. 10, p. 17.

Methods of Machine Tool Design

By A. L. DeLeeuw
Consulting Editor, *American Machinist*

Lubrication arrangements for slide-ways of heavy machines —Oil pressures for forced lubrication—Design of rollers for lubricating planer Vees—Bearing surface proportions

UNTIL NOW we have been dealing with ideal conditions—plates which were absolutely flat and absolutely level. These conditions are never met in reality. The surfaces of slides and slide-ways in machinery are nearly flat but not quite so. The unevenness in a slide may be quite small compared with the thickness of the metal, but may be quite large compared with the thickness of the oil film between the surfaces. This thickness of the oil film in medium-heavy machinery in which a fairly heavy oil is used may vary somewhat, but as a rule it is not more than 0.0003 in., and very often only a fraction of this amount. If the unevenness in the metal surfaces is greater than 0.0003 in., there will be metal-to-metal contact.

There will be very little wear with an oil film of sufficient thickness maintained so that there can be no metal-to-metal contact, notwithstanding the fact that the two surfaces may not be perfect. It will be so little, in fact, that it will not be perceptible after many years of work. It is not always practically possible to maintain such an oil film, but there are cases where it can be done without much complication. Planers and boring mills are instances of that kind. In a boring mill the sliding part completely covers the stationary part. Here we have two surfaces of the same size that are always in full contact with each other.

Force Feed for Boring Mill Table

In Fig. 242 is shown a section of the track of a large boring mill. If oil is forced between the two surfaces, an oil film will be formed and can be easily maintained by providing oil at the proper pressure. It might seem at first as if there would be some difficulty here because the load is variable. Sometimes there is a light weight on top of the table, so that there is practically no other load but the weight of the table; at other times, there may be a very heavy weight on top of the table and, in addition, a cut may be taken which causes an additional downward pressure. In one case we may have a pressure per sq.in. not exceeding 40 lb., and in another as much as 100 lb. It would seem that if the pressure of the oil should be 40 lbs. per sq.in., it would be just sufficient to lift the table out of metal-to-metal contact and, of course, not enough when the pressure is 100 lb. per square inch.

Again, it would seem that if we furnish an oil pressure of 100 lb. per sq.in., oil would squirt out between the surfaces when the table is lightly loaded. However, we do not meet this difficulty. It is not necessary, in order to maintain an oil film, to have an oil pressure equal to the pressure caused by the load. The writer well remembers the case of a large planer where the pressure due to the weight of the table alone was 75 lb. per sq.in. A system of forced lubrication was installed in which there was a relief valve which could be set for any oil pressure desired. To be sure that the oil pressure should not be too high at the start the relief valve was set for 50 lb. pressure, with the result that a screen of oil was thrown out from between the bearing surfaces. It was found that from 10 to 15 lb. per sq.in. was ample to counteract the pressure of the table at 75 lbs. per sq.in. We see, then, that the oil pressure does not need to equal the pressure caused by the load. It will be found that a very low oil

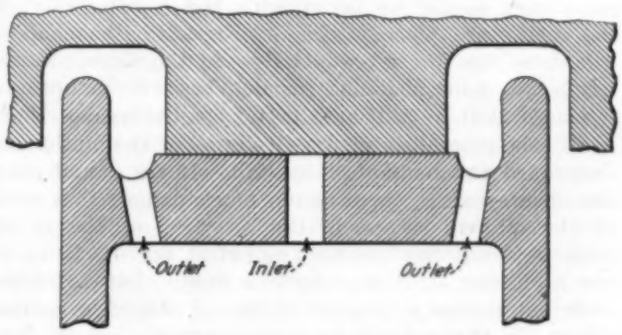


Fig. 242—Oil passages for bed of boring mill

pressure is sufficient to maintain the oil film and that this film, once established, will remain under very wide fluctuations of the load.

If a system of forced lubrication is installed, such as indicated by the diagram in Fig. 242, oil grooves and channels will not be required. The flow of the oil will be assured by the distance between the two metal surfaces. Of course, when using such a system the two surfaces must be very nearly true, because, if there are any great unevennesses, the oil film would be broken up when the two high points meet. Contrary to the popular idea which seems to prevail, large quantities of oil are not required. A very small oil pump working at low pressure will be found sufficient for a very large boring mill.

The condition is somewhat different for a planer. In this case part of the bed will be uncovered at times and some provision must be made so that the oil will not squirt out of the openings at the uncovered ways. This may be done by installing valves near the various

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openings from which the oil emerges, these valves being shut by the movement of the table before the table uncovers the openings. When the table is of medium length it will generally be found sufficient to have only one oil opening at the center of the table, but for longer planers it is advisable to have a number.

If both planer ways are flat no great trouble is experienced with the distribution of the oil. A few openings, perhaps only one, in the center of the width of the ways is all that is required. The oil flows into

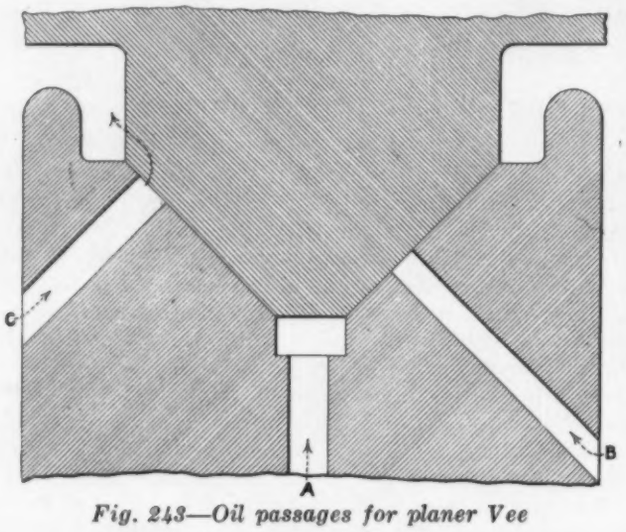

Fig. 243—Oil passages for planer Vee

channels along the ways and is returned to the pump. When one or both of the ways are of the Vee type, more cars should be taken with the installation. If the inlet were placed as at *A*, Fig. 243, the chances would be that the oil would flow in the little channel left between the male and female Vees. If the opening is placed at *B* we will have better conditions, but there is still the possibility of practically all of the oil flowing downward and none of it upward. If we should place the opening at *C*, there is too much danger that most of the oil will escape in the direction of the arrow without doing any good. The safest scheme it to let the oil enter at *A* and have a pump that furnishes sufficient volume so that all of the oil cannot be carried off by the channel left between the table and the bed. Proper precautions must then be taken so that the oil will not shoot out from the end of the table. This may be done either by a carefully constructed wiper or by providing pockets in the bed at intervals to carry off the surplus oil.

Even without forced lubrication oil films may be maintaned between surfaces, provided the unit pressure is not too high for the kind of oil used. The main rason why the results obtained in this case are not quite as good as those obtained with forced lubrication is that, in the course of time, dirt is apt to collect between the two surfaces and, unless this dirt is washed out, it will finally score the surfaces making more dirt, and so on. In the case of forced lubrication the new oil will wash out any little particles which may have come between the surfaces.

Before forced lubrication was used for planers and boring mills the common method of lubricating the ways was by means of rollers which were cylindrical when the ways were flat and conical when the ways were V-shaped. Even now, though forced lubrication is quite often used, the rollers are still employed in the majority of cases. Fig. 244 shows the lubricating rollers of a planer as generally made, but there are some very definite objections to this construction. In order to lubricate the entire surface of the ways, or nearly so, rollers of considerable thickness are generally used. It will readily be seen from Fig. 244 that the points *A* and *B* of the roller cannot travel at the same rate of speed and that the table, all points of which move at the same speed, tries to give uniform speed to all points of the roller. Consequently there must be considerable slippage between the roller and the table bearing. Furthermore, the lubrication of the table ways takes place when a part of the ways is over a pocket in the bed, but when this part passes the edge of the pocket nearly all of the oil is scraped off. This may be somewhat reduced, but cannot entirely be avoided by rounding the edge of the pocket.

In addition, let us suppose that the pockets are 4 ft. apart and that the planer works on a 3-ft. stroke. It may well happen that the end of the table moves at all times between two pockets and never receives oil. Altogether, this construction is by no means perfect, but it is much improved by arranging it as shown in Fig. 245. It will be seen that in this arrangement the table ways have a wider face than the corresponding ways of the bed. The roller is made wide enough to be of sufficient strength, but only that part of the roller which is near its largest diameter delivers oil to the table. This part of the roller is necessarily narrow and, therefore, the slippage cannot be very great. Furthermore, as the oil is delivered to a part of the table which does not pass over the edge of the oil pocket, there is no tendency to scrape this oil off. Every part of the table which passes a roller will

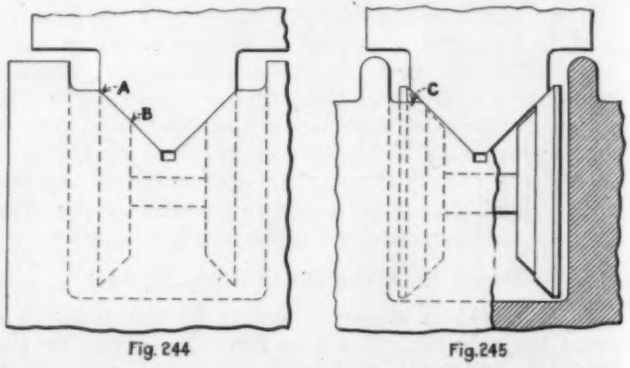

Fig. 244—Poor design of rollers for lubricating planer Vee. Fig. 245—Better design of lubricating rollers

receive and retain a certain amount of oil. However, this oil will run off and collect on the ledge *C*, from which it can be guided by means of grooves to any part of the ways.

The amount of oil delivered to the ways of the table is very small when the old arrangement of rollers is employed, but when either the arrangement of Fig. 245 or forced lubrication is used, the amount of oil given to the ways of the table is so large that it will run off when part of the table overhangs. It is therefore necessary to have catch-basins attached to the bed and extending far enough to collect the oil, even when the table is in its extreme position forward or backward. When the rollers shown in Fig. 245 are used, the amount of oil delivered to the table ways is so large that a pocket will soon be drained of its oil. This oil may be collected again by some other pocket

or it may run off the table into the catch-basin at the end of the bed. It is therefore necessary, when using this style of rollers to connect the various pockets and the catch-basins by means of pipe that will maintain the same level in all of the pockets.

The arrangement shown in Fig. 245 has the disadvantage that the ways of the table project beyond the ways of the bed. This would ultimately result in a shoulder wearing in the table ways. To prevent this the arrangement should be made as shown in Fig. 246, in which a different level of the table ways receives the oil.

A boring mill track, such as shown in Fig. 242, does not require rollers if there are proper means for oiling the track at a sufficient number of points. If the track is arranged with a fairly high ledge on each side, as shown in Fig. 242, there will be a large annular oil pocket which might be filled, so that the track of the table runs in a bath of oil.

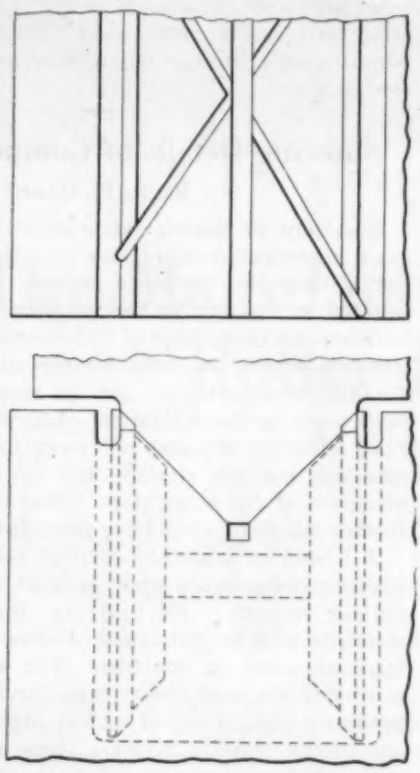

Fig. 246—Good design of lubricating rollers for Vees

Care should be taken when using this arrangement to renew the oil and wash out any dirt that may have collected, at fairly frequent intervals. Though it would seem from the illustration that the track is well protected, and though it might be possible to make this protection much more complete than is shown in the illustration, dirt will creep in, especially if a large part of the work is cast iron. Fine cast-iron dust will float in air, so that it is even an extremely difficult matter to remove all of this dust by means of an exhaust fan and filtering system. This fine cast-iron dust will creep in anywhere and is very apt to come in at the bottom of the boring mill to drift up again and lodge, in the course of time, in the oil of the track. This warning does not merely apply to boring mills, but also to any machine in which no proper provision is made for washing out the oil used on the bearing surfaces.

The ways of a machine serve two purposes—as supports, and as guides. The track of a boring mill, as shown in Fig. 242, serves mainly for support. There has been, and still is, a great deal of difference in the minds of various people as to the permissible pressure per sq.in. It is not possible to say in a few words how much this should be. On the other hand, in most machines it is so easy to provide ample bearing surface—in other words, to keep the pressure per sq.in. down to a low figure—that there is seldom cause for worry. Let us take, for instance, a large boring mill with heavy table receiving heavy castings and in which the downward pressure resulting from the cut may be very large. Let us suppose that the table is 16 ft. in diameter, that it has a track of which the average diameter is 14 ft., that the table weighs 60,000 lb., that it has to receive a load of 130,000 lb., and that the pressure of the cut is 10,000 lb. Then there is a total weight or pressure on the track of 200,000 lb. This pressure is taken up by a track whose diameter is 14 ft., so that the average circumference is 44 ft., or 528 in. If now we wish to keep the pressure down to 50 lb. per sq.in., we would need 4,000 sq.in., so that a track 8 in. wide would be more than sufficient. A pressure of 50 lb. per sq.in. is exceedingly low, even with the most ordinary means of lubrication. Where means are provided for ample lubrication, one does not need to hesitate at 100 lb. per sq.in., and even 200 lb. is, as a rule, not excessive.

For another example, consider the case of a planer. Let us suppose that the planer table is 30 ft. long, weighs 100,000 lb., and may receive a load, due to weight and cutting pressure, of 200,000 lb. Then the total load to be taken care of is 300,000 lb. As the table may at times overhang a certain amount, let us say 5 ft., this total pressure may have to be sustained by 25 ft. of the ways, so that there will be a load of 1,000 lb. for every inch of the table ways. If we should make each way 10 in. wide, we would have a pressure of 50 lb. per sq.in. This shows, again, how easy it is to sustain very heavy loads without going to excessive dimensions in the supporting ways of a machine tool.

Of course, planers and boring mills by their very nature furnish large areas of support. We have different conditions in a lathe. On the other hand, by far the greater part of heavy loads in planers and boring mills are the weights of the tables and the loads they carry, whereas in lathes and similar machines there is nothing but the weight of the carriage and the downward pressure caused by the cut. We find then that, though it is not possible to provide as much bearing surface in a lathe as we can provide in a planer, it is not necessary because the load is very much less. It is possible in heavy lathes with flat ways to provide sufficient bearing surface for the carriage to keep the pressure down to a very low figure. When a heavy lathe is made with Vee bearings we have a somewhat different condition. In the first place, it is not practical to make a Vee bearing very wide, so that we cannot have many square inches of support without making the carriage excessively long. In the second place, the Vee bearing does not lend itself to good lubrication. It is therefore advisable to use flat ways for the heavier types of lathes, confining the use of Vees to the lighter machines where the pressure will never be very great.

The Department of Commerce announces that, according to data collected at the biennial census of manufactures, 1923, the establishments engaged primarily in the production of emery and other abrasive wheels and of polishing and buffing wheels, belts, disks, etc., reported products valued at $25,306,812, an increase of 101.5 per cent as compared with $12,558,834 in 1921, the last preceding census year.

Observations from the Wildwood

Setting Up a Simple Job

By R. B. Willis

A while ago I had something to say about a few simple precautions to insure good work. To go a little further into the subject of precautions, it will be of interest to follow a simple job up to the time cutting begins.

My object is to show what we all know without thinking much about it, that the machinist has to have a lot of knowledge right at hand every day. He can't get his case continued while he looks up precedents and authorities.

Suppose the job is to plane a slot ½ in. wide and 1 in. deep across a piece of cast iron 6 in. wide. We hope to have the slot within 0.002 in. of figures for depth and width, that the slot will run square with one side of the piece, square with the bottom, and that the bottom of the slot will be parallel with the bottom of the piece.

At the start we shall have to take a few things for granted, so we will suppose that the piece is easy to hold down on the shaper table, and neglect the possibility of its being sprung by planing.

Since the job is to be done in an average shaper in an average shop, the top-notch machinist will take nothing for granted about the machine. He will probably find the ram loose sidewise, and will take up the gib, if it is that style of gib, by tightening each gib screw until the ram goes rather hard, then loosening the screw until the ram goes easily. This assures him that the ram will travel as nearly straight as the condition of the ways will permit.

The usual method of tightening a gib is to turn all the gib screws equally until the ram seems to go about right, and the result is not worth much because there is no way of knowing whether one screw is doing all the holding or all are holding.

Down Slide and Clapper Box

The machinist will of course tune up the gibs that hold down the ram before looking into the condition of the down slide. The down slide will be found to run loose toward the top of its travel and to bind at the lower end. After adjusting the down-slide gib, the next thing will be to wipe the clapper box out dry, removing the oil put there with the best of intentions.

The shaper table usually needs attention, it being necessary to file off the lumps, especially at the edges of the T-slots, and then it is time to set the down slide to travel at right angles with the table, or knee. The top-notch machinist long ago lost all faith in zero lines, so he may take the time to clamp a square on the table and to test the travel for 2 in. or so with an indicator held in the tool post. Yes, he may also set the square itself square with the edge of the knee. He won't injure the square by clamping it down, because there again he knows how.

While he is taking precautions regarding the down slide he will save himself a lot of trouble by setting the clapper itself square with the table so that the tool will act nicely on the return stroke while the slot is being planed.

I will not try to enumerate all the precautions necessary to the setting of the work and strapping it down, except to mention that the work must be set so that the tool travels at right angles with one edge of the work, and that setting the work by a square from the edge of the table will not necessarily bring the work right. The direct way is to set by the edge of the work itself.

Now comes the tool itself, but there are several niceties connected with it, and the man who can get a tool ready to plane a slot 1 in. deep without giving several kinds of trouble knows a thing or two. I will not discuss this matter further, having said enough to show what I mean by saying that a machinist has to have a lot of knowledge.

I had a great idea some years ago. It was to have typed a list of things to look out for in setting up an automatic gear cutter, and to put it up where the operator could use it as a guide. The list never was finished. Just the other day a gear was spoiled in a way new to me.

Showing Details of Competitors Work

By R. E. Marks

Questions in machine shop ethics seem to be getting more complicated every day and there may be a field for a book on "How to Behave in Polite Society," devoted exclusively to the problems of the machinery builder. In these days of counting unit costs, when we use one type of machine for certain work and another for different parts, we aim to keep down the cost of each piece to the minimum. Likewise we do not as a rule, advertise the cost per piece to our loving friends who are making similar, but of course inferior(?), machines of the same class. This may be more or less foolish but most of us have prejudices against it.

A friend of mine had similar notions and had them rather rudely shaken when he went to consult a machine builder recently. He told Mr. Builder what sort of work he had in mind and wanted to know what his machine could do for him. For answer Mr. Builder consulted his card index, rang for file number 827 and produced blue prints of almost identical pieces used by one of my friend's rivals. These prints were marked with all dimensions and had the time for each piece and the name of the maker, so that there could be no mistake about it.

The machining times were good, better than my friend was getting, and this particular machine looks good to him. He would also like to get suggestions as to tooling for his particular work and some production estimates, but he isn't exactly pining to have his drawings put in exhibit number 953 and used to help sell this man's machine. He is debating whether to fake up some drawings near enough like his to get what he wants, or to buy a machine, tool it up his own way and take a chance on beating or at least equaling the time Mr. Competitor is making.

Investigation of the Wearing Properties of Steel

Several spherical specimens have been prepared by the Bureau of Standards and as soon as they are heat-treated and the surfaces are finished they will be tested in a small rubber-lined ball mill with approximately the same abrasive as was used in the lapping tests on these same steels, according to Techincal News Bulletin No. 91 of the Bureau of Standards.

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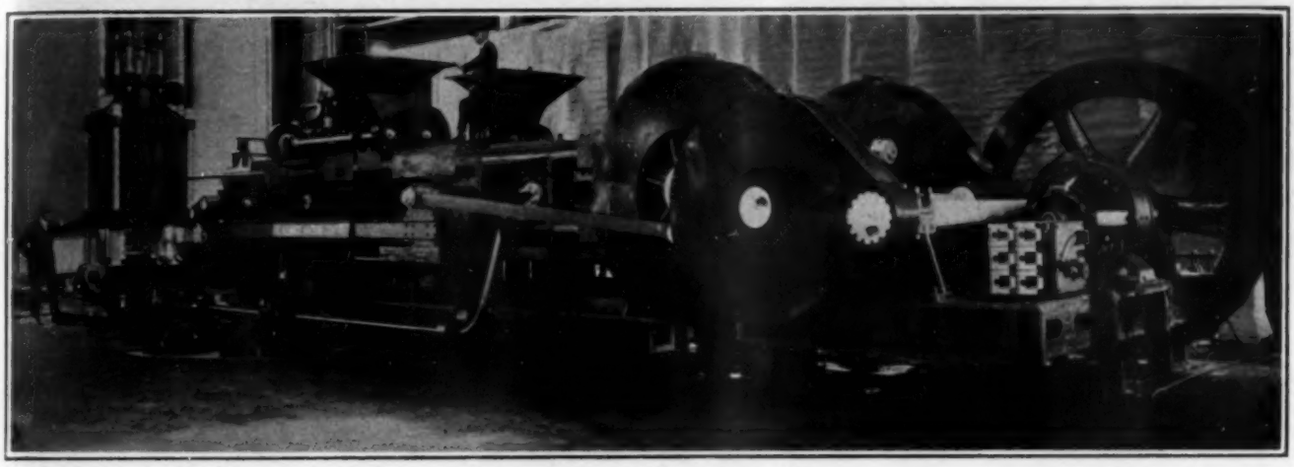


Fig. 1—The briquetting machine

The Manufacture of Tapered Roller Bearings

By M. T. Lothrop
Vice President, Timken Roller Bearing Co.

Continuous process from ore pile to finished product—Uniform control of material, processes, assembly, installation and use—Grinding and inspecting to quarter-thousandth limits

THE Timken roller-bearing plant is unique in the respect that it is the only plant making a diversified, highly-fabricated product in continuous process from the steel furnace to the finished product. Conservation of material is carried out to a remarkable degree, twenty-five tons of raw material making fifteen tons of finished product. Actually one hundred tons of ingots make fifteen tons of finished product but the most of the eighty-five tons is recovered and used over again so that there is only a small loss.

The process starts at the scrap pile, which is composed of (a) the turnings from the various machine tools, (b) the crop ends of bars and tubes, (c) defective raw material from the steel mills and defective product at various stages of fabrication, (d) scrap purchased from outside sources. Roughly speaking, about half of this is of such nature that it can go directly into the steel furnace. The remainder, consisting mostly of the turnings and smaller scrap, is fed into a briquetting machine of the company's own design and is shown in Fig. 1. The small scrap is collected by an electro-magnetic crane and deposited on a platform, whence two men rake it into two large hoppers. At the necks of the hoppers are large oscillating teeth which shred the scrap and at the same time pack it into cylindrical briquetting-dies. At the proper moment a hydraulically operated ram pushes a charge forward along the cylinder and is met by an opposing ram which squeezes the charge under a total pressure of 350 tons. This forms a cylindrical briquet 7 in. in diam. and 3½ in. long, weighing 17 lb. (see Fig. 2) which is seventy per cent of the weight of solid steel.

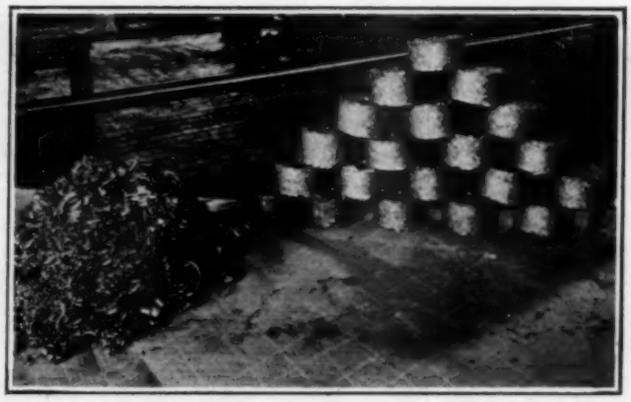
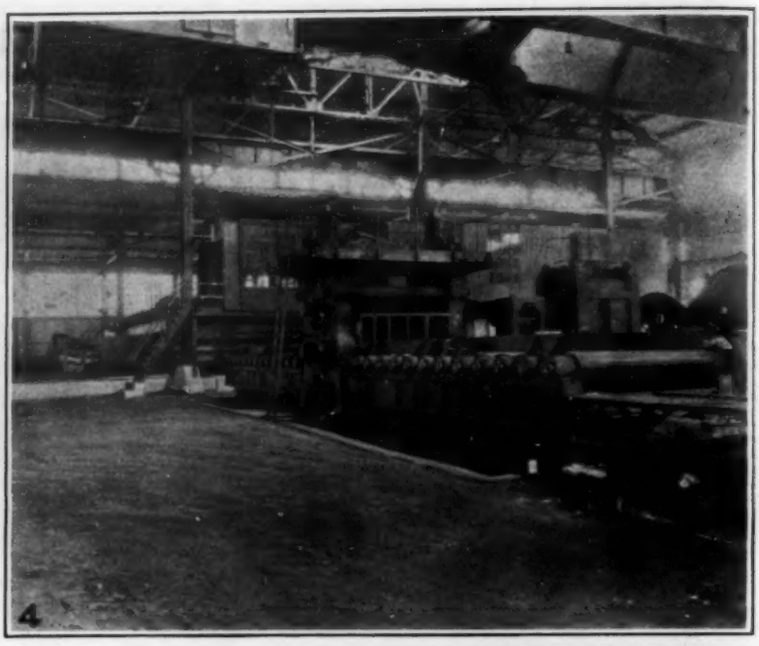
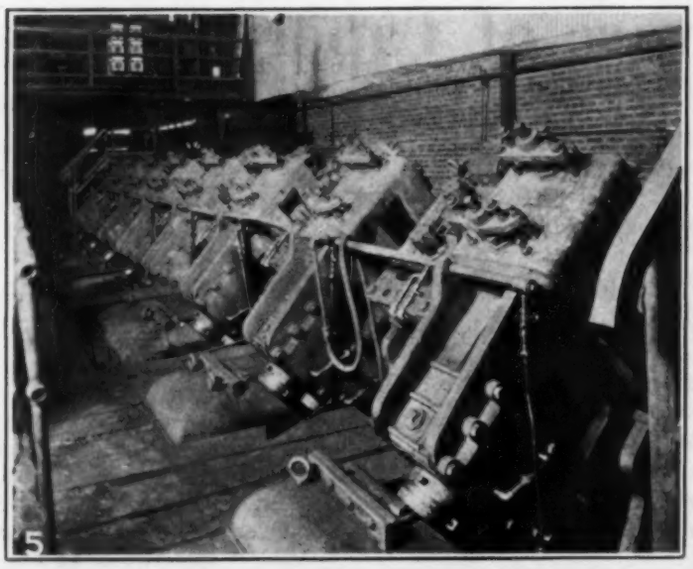
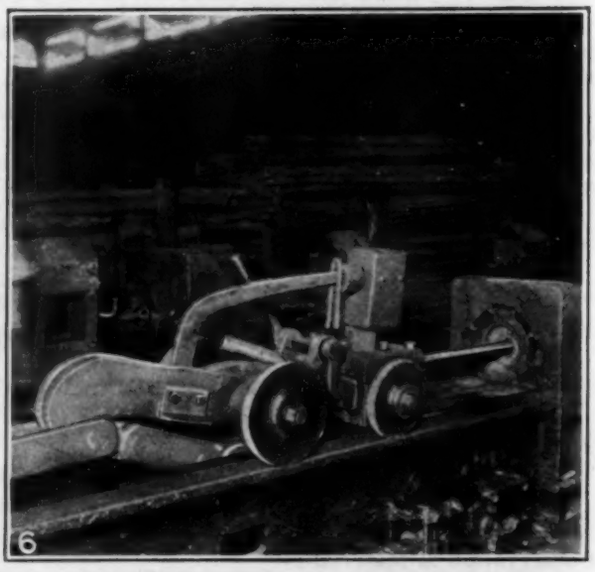


Fig. 2—The briquettes

The briquettes are discharged at the bottom into a conveyor and are carried up to the top of a circular furnace where the oil is burned off. No additional fuel other than that in the pieces is used and no use is made of the heat generated, though possibly it could







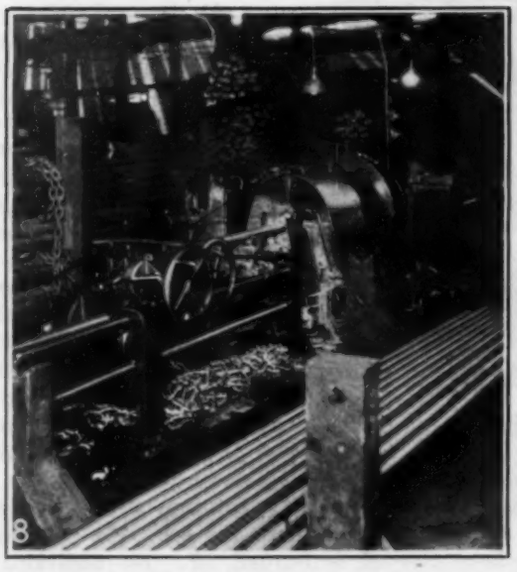


Fig. 3—A 6-ton Herault electric furnace. Fig. 4—The 35-in. blooming mill. Fig. 5—Reducing mill. Fig. 6—cold drawing. Fig. 8—Centerless tube-turning machine. Fig. 9—Wire mill

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be used for water heating or some such purpose if desired, and if not too costly. The capacity of this unit is 6 tons of finished briquettes per hour.

Tumbling out of the bottom of the furnace the pieces are picked up by a magnetic crane and either carried to a stock pile or direct to the electric furnaces.

There are four 6-ton Herault-type electric furnaces, Fig. 3, the whole series capable of 22 heats per day or rather over 100 tons average per eight hours. Weighed quantities of briquettes, heavy scrap and lime

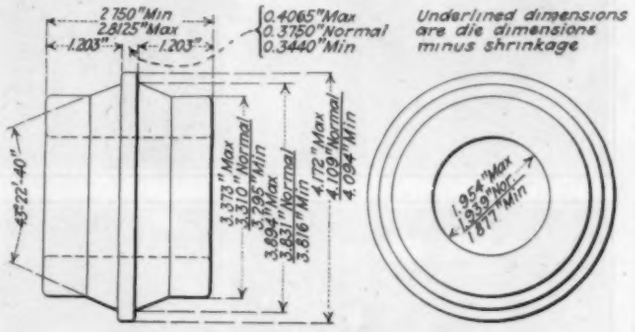


Fig. 7—Drawing of double-ended cone

are placed in the furnace and after the metal is melted, in about 1½ hr. time, the first slag is rabbled off and a sample taken of the metal. Up to this point the mixture is in a sense unknown, but the sample is analyzed, a chemical determination being made of the nickel present, a color test made for the molybdenum and a combustion test for the carbon. This is done in less than twenty minutes and the result reported by telautograph to the furnace room. The mixture is then "doped" with the necessary ferro-molybdenum and ingot nickel, or is further reduced to get the desired analysis. A second test is made after the reducing slag has "shaped up," for carbon and manganese contents.

The desired specification which is rapidly becoming standard for the cups and cones and the tapered rolls is

0.15 to 0.20 per cent Carbon
0.40 to 0.60 per cent Manganese
1.15 to 1.65 per cent Nickel
0.20 to 0.30 per cent Molybdenum
Phosphorus and sulphur below 0.04 per cent.

These are the desired figures but in actual operation the electric furnace can control the charge well within them. The analysis is numbered and follows the fabrication of the heat throughout the plant.

When the heat is ready it is tapped into a ladle and poured into ingots in the usual way. The ingots are placed in soaking pits and are drawn as required for the blooming mill. In this mill, Fig. 4, the table or conveyor rolls are all mounted on Timken bearings. Similarly, the cranes in the steel mill are all running on Timken bearings and the results are justifying their adoption. It might be mentioned that it is a policy of the company to specify the use of its own product on all equipment purchased, including many machine tools.

The blooms or billets are rolled to a standard size, approximately 8 x 9 in. x 7 ft. long. After pickling, each billet is inspected for seams and shuts and all such are chipped out with pneumatic chisels. Any showing evidence of bad seaming are immediately rejected, and returned to the furnaces.

One heat forms four ingots and the four ingots form eight blooms. From one of these eight a chip is taken and is carbonized under specific conditions of time, temperature and compound. The chip is then fractured, etched and polished, and by microscopic examination it is decided whether the material in the blooms will carbonize properly. If not the whole eight blooms are rejected to the scrap heap. This happens very rarely, however. Some 20 to 25 checks of this nature are made every day.

The blooms then go to the rolling mill where they are rolled, usually into rounds, but sometimes into squares. A hot saw cuts off the rolled product to predetermined lengths, according to the fabrication requirements. Here it should be noted that each furnace heat is made not merely for the purpose of making steel, but for a specific product desired later on. This is a part of the unique control system in evidence everywhere.

Here also additional precautions are taken by scrutinizing each round or square and chipping out any seams that show, before further fabrication. The laps at the ends of the bars are also cut off and returned to the scrap heap. It will be understood that seams, checks or shuts are fatal to the successful operation of roller bearings.

Races Made from Tubing

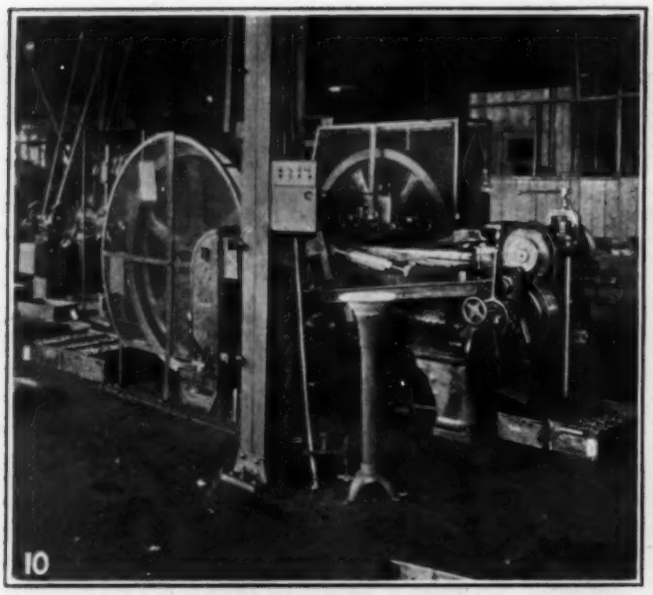
Since bearings are usually mounted on some part, there is always a more or less generous hole in the inner and, of course, in the outer races. To economize in material and on fabrication it is advisable to use tubing and Timken makes its own.

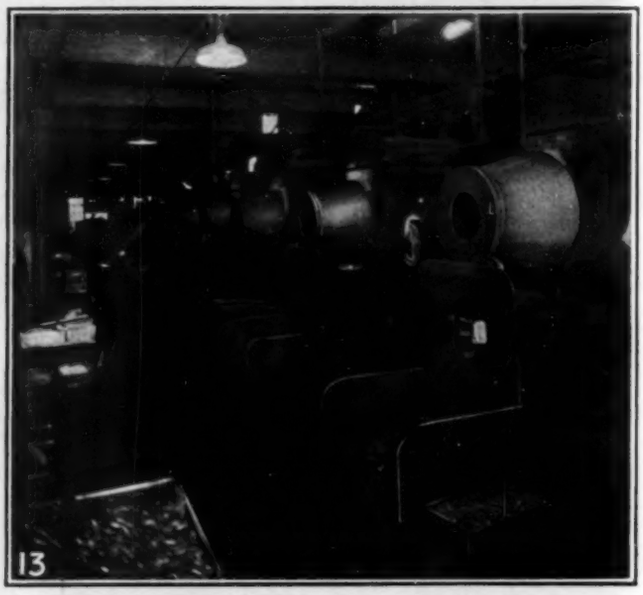
The cut bars are heated in a long furnace to some 2,250 deg. F., and are fed in to a tube mill of the Mannesman type, where they are pierced and appear at the other end as tubing. Incidentally the piercing nose is never used twice running, but is replaced for each tube by a cooled one. The tubes then pass to a second mill where they are further rolled over a mandrel to smooth out the grooving left after the Mannesman rolls. They then pass to the reducing mill, Fig. 5, where they are rolled down to the size required. This virtually finishes the hot operations.

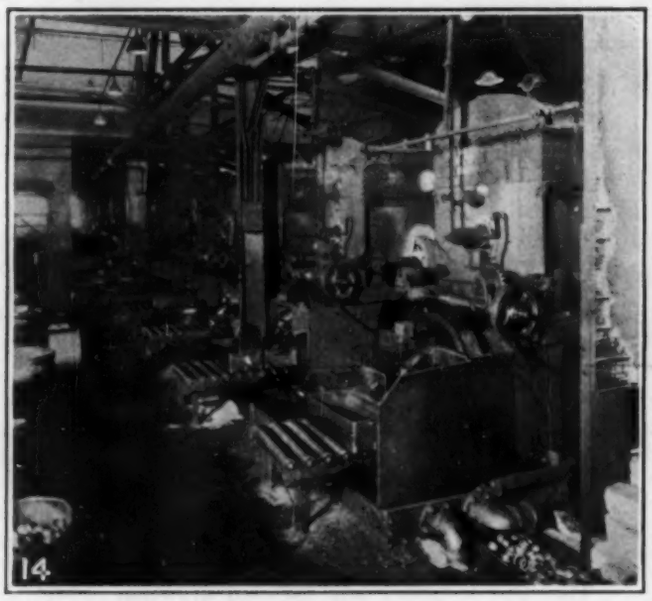
The tubing is then pickled to remove scale and is inspected to see that there are no seams. Where present, seams can usually be taken out with a carborundum wheel or by light chipping. If, however, they go too deep the defective piece is cut out by oxyacetylene torch and relegated to the scrap pile.

It might be noted in passing, that the pickling room is a large wooden structure with the crane and craneways the only metal parts exposed to the acid fumes. The wood is soaked with a tar preparation to avoid corrosion and the crane parts are, of course, well protected. The sulphuric acid baths are doped with "pickelette" to keep down the fumes that would otherwise arise.

The tube is now ready for cold drawing. First the end is smashed down for a distance of about 9 in. under a forge hammer, then gripped by the end, and pulled







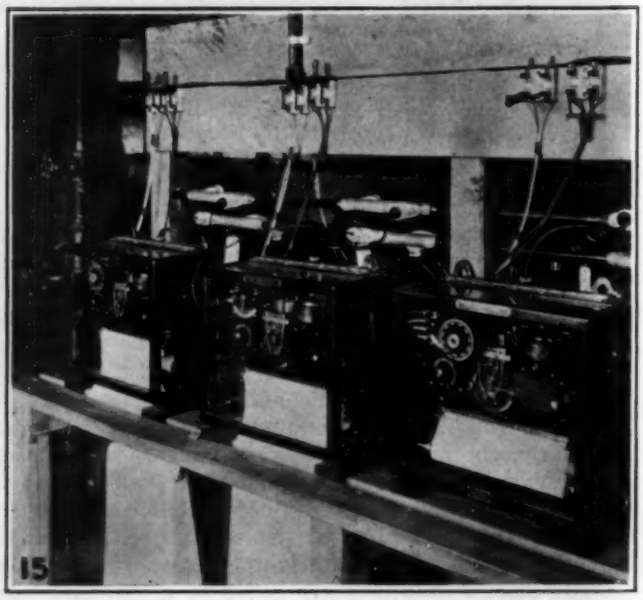


Fig. 10—Upsetter for "heading up" rolls. Fig. 11—Carbonizing pots. Fig. 12—Casehardening furnace. Fig. 13—Hardening furnaces—front. Fig. 14—Hardening furnaces—back, showing cooling stream. Fig. 15—Leeds & Northrup potentiometer control

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through a die and over a mandrel, Fig. 6. No annealing is done during this process.

Some of the tubing is cut to length and is forged or upset in Toledo presses to its approximate finished shape as shown in Fig. 7. This is done hot. Some of the tubing goes to turning machines which are virtually "centerless" lathes in which the part being machined is stationary and the tools revolve. The tubing is fed in at a speed of about 2½ ft. per minute by means of rolls driven by gearing from a motor. First a roughing tool, followed some 24 in. further on by a finishing tool, takes 0.050 in. off the wall. The tools are single and are shaped like long shaving tools, 2 in. wide and ⅝ in. thick with a very sharp lip, Fig. 8. They are backed up by a bronze steady collar bearing on the work and revolving with the tool.

A feature in this department and one that may be extended elsewhere is the means of handling the chips and cutting compound. Both fall into a tunnel below the machine, the compound gravitating to a trough and being pumped back. The chips lie in the tunnel and are picked up by a small traveling magnet which automatically picks them up as they travel and carries them to a hopper where a switch is automatically tripped, thus dumping the load. The crane then returns and repeats its cycle.

Tapers Formed in Upsetting Machine

Timken makes its own wire from its own blooms, and through the usual type of wire mill, Fig. 9, coils it into 300-ft. lengths. It is pickled to remove scale, inspected for seams and is then cold drawn. The end is pointed in a rotary swaging machine and is then placed through the drawing dies, gripped and the wire pulled through. The lubricant used is commercial vaseline. Dies will stand up to some 12 to 20 coils before regrinding to the next largest size. The smaller wire is left in coils—the larger is cut into straight lengths about 16 ft. long. Diameters run from ⅛ to ½ of an inch.

The coils or rods then go to the upsetting machines, Fig. 10, where they are formed into the well known taper shape, and at the same time the necessary countersinks are made for the grinding centers to be used later on. The first traverse stroke cuts off the blank to the proper length and the second longitudinal stroke upsets or heads it to the taper shape. The third stroke, also longitudinal, punches or sinks in the conical countersinks. The largest blank made is from ½-in. wire or rod and is approximately ¾-in. diameter at the large end, ⅝ in. diameter at the small end and 1¼ in. long. Inspectors travel around the shops constantly watching for seams and poor countersinks. One seam in a roll will reject a coil.

The blanks are then taken to the casehardening department which is worth noting. The operations of this department are the same for rolls, cups and cones, so one description will do for all.

The first process is carbonizing in which the pieces are packed closely in a slow acting compound—Houghton's hydro-carbonated bone meal. Nichromé pots are used of standardized design, 16½ in. in internal diameter and 16-in. deep with walls about ⅜-in. thick. A chimney of 3½-in. bore goes through the center of the pot. The pot is supported by four lugs in the circumference and one supporting lug at the chimney, Fig. 11. The chimney is important as it serves to bring the heat into the center of the pot. As many pieces as can be put in are placed in the pot. If one piece touches another by accident it matters very little as with this slow acting compound carbonizing goes on equally well. The bone meal is used over again, about 25 per cent of new being added to the old mixture.

Pots are left in the furnace, Fig. 12, from 12 to 24 hr., depending on the depth of case required. The temperature of the furnace is 1,700 deg. F. The center pot is pulled out at the expiration of the allotted time and an inspector takes two or three pieces out for a fracture and etching test to determine if the case is the proper depth. If so the pots are allowed to cool off slowly and are then dumped over a sieve which retains the product but allows the compound to fall through where it is caught in a conveyor and brought up to be remixed.

The parts are then reheated to 1,520 deg. F. and quenched in running cold water. A second reheat to 1,430 deg. F. is found desirable with a quench in cold water.

The furnaces are oil fired. Most of them are of the rotating-drum type, the parts being fed in by a hopper or by a rotating scoop and being carried on the circular table till they are swept off through an opening into the quenching stream, Figs. 13 and 14. In addition to the control by Leeds & Northrup potentiometers, Fig. 15, there is also a direct automatic control on each furnace, whereby its temperature is held within a variation of 5 deg. either side of the predetermined amount. One man devotes his whole time to the maintenance of the potentiometers, the couples and the control system. In addition, constant checks are made by fracture and by microscopic analysis to insure that uniformity of results will exist.

(To be continued)

Abstracts

from other publications

Light Alloys

The use of light alloys is grouped by J. B. Swan into three parts; first, parts that are not subject to severe shock, loading or temperature. These are for example, the crankcase, transmission and similar parts. The main essentials of an alloy suitable for this work are that it should have a good tensile strength of about 14 tons per sq.in., should be as hard as possible and have as great an elongation as possible. Resistance to shock need not necessarily be great.

In the second group are parts subject to dynamic stress, such as rear axle housings and torque tubes. An ultimate tensile strength of 12 tons per sq.in. is desirable, but the elongation should be at least 7 per cent in a 2-in. gage length.

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The third group are those parts subject to high temperature and medium dynamic stress such as pistons, cylinder heads, and exhaust and inlet manifolds. The tensile strength should be at least 7 ton per sq.in. at 250 deg. C. Some alloys will give a tensile strength of 10 tons per sq.in. at 250 deg. and in all cases an elongation of not more than 1 to 2 per cent in a 2-in. gage length can be obtained.

With high-efficiency water-cooled engines, the piston temperature reaches a maximum of about 275 deg. C. after prolonged running. Under the same conditions with a cast iron piston the temperature would rise to 450 deg. C. with a consequent loss of power of about 6 per cent, so the gain in using aluminum is very obvious.

There might be a fourth group which would include such parts as are suitable for light forgings, particularly, connecting rods. It is stated that a few alloy crankshafts have been tried using ball or roller bearings, but the art is not sufficiently advanced to recommend this.

One interesting statement that is brought out by mathematical reasoning is that light alloy connecting rods would have to be at least 1¼ times as heavy as those made from good alloy steel and are not recommended for high-speed, high-duty engines.

The article then proceeds to give composition, physical and chemical of the various alloys. It is also stated that magnesium alloys have been used with success in France and Germany for aircraft engine crankcases and for pistons. The saving in weight in the crankcase is some 35 per cent over aluminum.

There are also two tables summarizing the composition of the alloys, outlining their recommended advantages. There is also a table giving composition and conductivity at various temperatures.

Altogether this is a very detailed article worth studying by those interested.—*The Automobile Engineer* (England), October, p. 293.

Packard Test for Bearing Clearances

The Packard Motor Car Co. is distributing an oil test tank for testing bearing adjustments on new engines. The test tank is filled in service about two-thirds full of oil, and its hose connected to the oil manifold. Air is then pumped into the tank through the tire valve provided for the purpose until a minimum pressure of 30 lb. is shown by the gage. The oil gage on the instrument board should also register this pressure except when cylinders 1 and 6 are on upper dead center, as in this position there is a direct flow of oil through the camshaft to lubricate the front-end drive.

The next step is to turn the engine over by hand. The flow of oil from the main and connecting rod bearings will be in drops before reaching the floor and should be at the rate of from 20 to 60 drops per minute. If the flow from any bearing is less than the lower limit, its clearance is too small, and if the flow is more than the upper limit the clearance is too big.

This idea might be used for other purposes as well.—*Motor World*, Oct. 9, p. 27.

Grinding Chrysler Motor Parts

The article describes principally the department that supervises the grinding equipment used in the Chrysler plant. Here the wheels are mounted, balanced and salvaged. The equipment consists of two lathes for boring and siding wheels, balancing ways, a bushing chuck, wheel storage racks, etc. Before this department was instituted, under-size wheels were thrown away and now the saving from this alone amounts to approximately $1,500 per month.

Wheels that have outlived their usefulness on one operation frequently can be rebushed or re-turned, or both, and made serviceable for another job. The wheel lathes are of the same type as used in grinding wheel manufacturing plants, while cone cutters are used extensively for facing and boring operations. By rebushing wheels can be adapted readily to a number of spindle sizes. This practice eliminates the necessity of carrying a large number of wheels in stock to fit the spindles of various machines.

It is also stated that the fine grit carbide-of-silicon hones used for finishing cylinders wear out of shape and that by grinding their faces flat and regrooving them, they are given another period of usefulness.

Consideration is given to the operation of finish grinding crank pins. The machine used is a Landis crank grinder, equipped with an artificial alumina oxide wheel, of 26-in. diameter, 1¾-in. face, 24 combination grit, M grade. This wheel is run at a peripheral travel of approximately 6,000 ft. per minute. The work is located in crankheads and backrested at the pin in process of grinding. These pins are 1¾-in. diameter and 1⅞-in. long. In removing 0.01 in. of material the grinding time is 3 minutes per pin.

The main bearings are ground on Landis plane grinders, capable of accommodating work 12 in. in diameter and 36 in. long as illustrated in the article. This machine is equipped with an artificial alumina wheel of 24-in. diameter, 1⅛-in. face, 24 combination grit, M. grade. This wheel is operated at an approximate peripheral travel of 6,000 ft. per minute. The work is located between centers in the usual way and backrested over the bearing in process of grinding. This machine is fitted with an automatic gage for registering the diameter of the work as it is ground.

The crankshafts are balanced on Olson and Gisholt dynamic balancing machines.

Pistons for Chrysler motors are aluminum alloy. They are roughed, turned and finished by grinding. Three grinding operations are involved in finishing. They are roughing the skirt, roughing and finishing the head, and finishing the skirt. The grinding is performed on special piston grinding machines capable of accommodating work of 10-in. diameter and 24-in. length, fitted with carbide of silicon wheels of 18-in. diameter, 2-in. face, 36 grit, M. grade. The operation speed is approximately 6,500 ft. per minute. The work is located over a headstock fixture and driven by a pin that engages one of the piston pin bosses. The piston head is supported by the tailstock center. From 0.015 to 0.018 in. of material is removed.—*Abrasive Industry*, October, p. 251.

McCarrell "Constantmesh" Transmission

By W. A. McCarrell

A transmission by which changes of speed can be effected without appreciable noise or shock — Either spur or helical gears can be used

GEAR shifting as related to the various types of sliding gear transmissions has been one of the big drawbacks to automobilists, leaving something to be desired in the hands of all but the most expert drivers. Those who can shift from low up to high with any degree of uniformity and quietness are in the minority and in spite of the known advantages of the engine as a brake in hilly country, but very few people have any luck in shifting to the next lower reduction while the car is moving at any appreciable speed. This condition is almost entirely chargeable to the inherent characteristics of the sliding gear transmission. Some manufacturers have alleviated this condition to a partial extent by using clutches having very light rotating members but the momentum of the gears in the transmission, plus the number of contacting points at the tooth ends, prohibit any great advance in this particular direction.

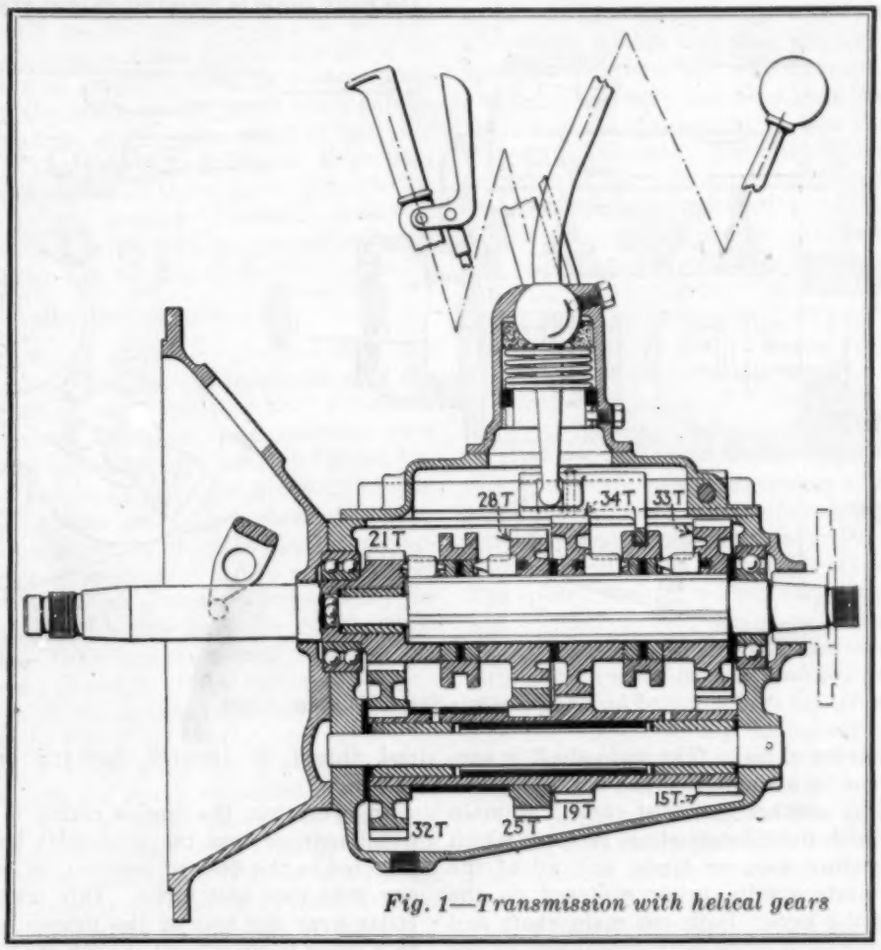


Fig. 1—Transmission with helical gears

In many designs, the clutch also plays a part in detracting from the case of gear shifting. In some cases, the clutch does not release freely because of a dragging action. Any of these things work to the disadvantage of the ordinary driver, and may be responsible for accidents or prevent an otherwise satisfactory car from fulfilling its full measure of service.

The solution of these difficulties would seem to be some type of transmission in which the various reductions can be engaged in any reasonable sequence when shifting either up or down. Also, a transmission in which the effect of dragging clutch is reduced to a minimum. Furthermore, in view of the element of competition which now prevails in the automobile field, the transmission or other device which fulfills these conditions must be simple in construction and therefore capable of economical manufacture.

In getting away from the clash gear, the first step was the friction type of transmission which has practically disappeared due to its obvious disadvantages. The next step was the constantmesh transmission in which the gears were engaged at all times and the reduction varied by picking up and locking the desired gear to the shaft. This type has a rather long history in which the element of failure or success is related almost entirely to the method of performing the latter function and the noise characteristics. It is the purpose of this paper to describe a type of constantmesh transmission that has demonstrated its ability over a long period of test and road work, and a type that combines silence, ease of operation and ease of production.

The McCarrell "Constantmesh" transmission as illustrated in Fig. 1, bears a considerable resemblance to the conventional three speed and reverse type, in that the gears are arranged in the same order from front to rear

Abstract from a paper presented before a meeting of the American Gear Manufacturer's Association, Oct. 18, 1924.

and reductions are obtained through step down gears at the front end, which in turn drive a lower shaft fitted with fixed gears engaging with corresponding gears on the tail shaft. Although shifting is accomplished by the usual hand lever mounted in a spherical bearing (or mechanical shift), slip collars, rather than the gears on the upper shaft are moved to engage the various reduction sets.

Again referring to Fig. 1, the desired type of conventional clutch is mounted on the outer end of the shaft at the left, the shaft carrying an integral step-down pinion and a roller cage at its inner end. A two-row annular ball-bearing is shouldered against the forward side of the step-down pinion and restrained by a cap threaded at its bore to act as an oil retainer. The tail or main shaft is centered in the clutch shaft by a roller bearing, and the end thrust of the propeller shaft is transmitted to the two-row bearing at the front by an assembly of

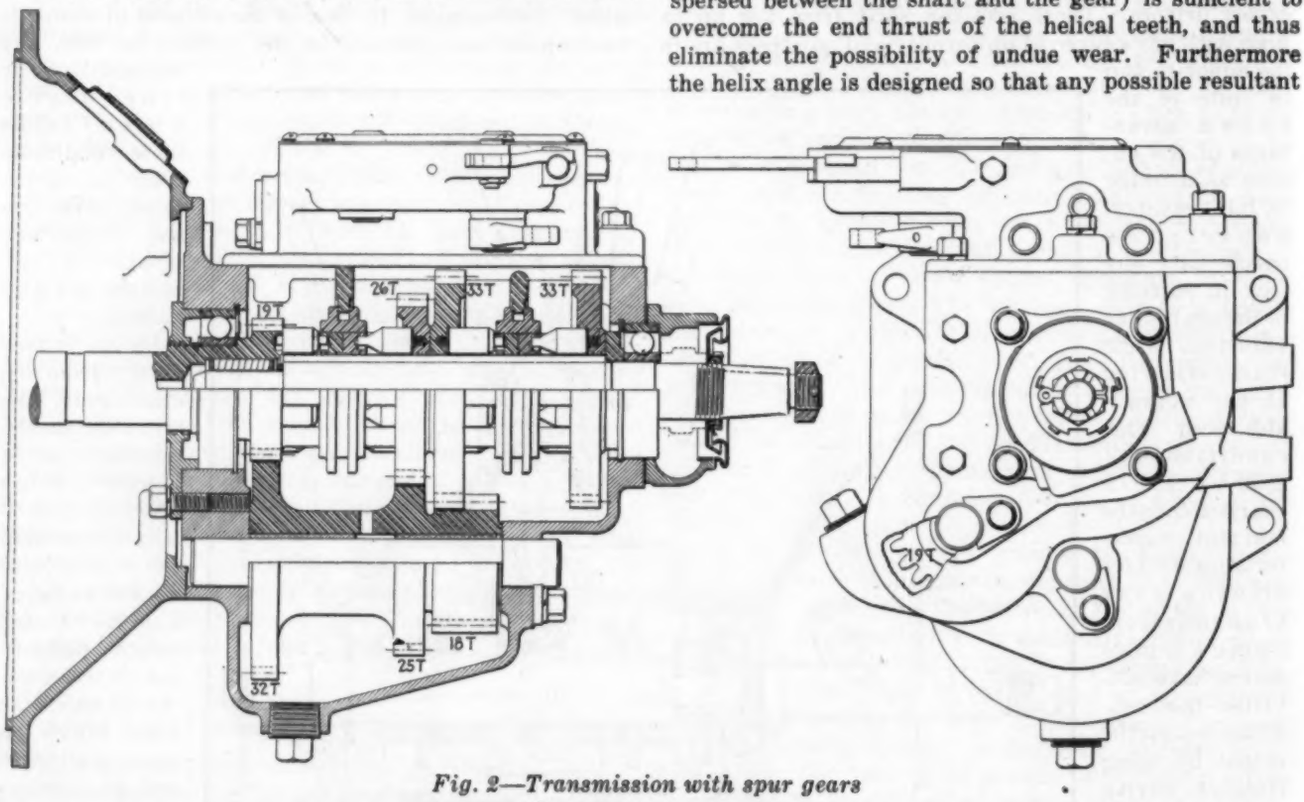


Fig. 2—Transmission with spur gears

three balls and a hardened disk. The main shaft is supported at its rear end by a single-row ball bearing which is also restrained by another threaded cap. The main shaft is machined with three longitudinal recesses which leave three outstanding keys or lands, and all of the reduction gears rotate freely, being centered on the outer diameter of the keys. Both the main shaft and the step-down pinions are made with extensions at the hubs. As the parts leave the lathe, the extensions are $2\frac{3}{8}$ in. diam. and $\frac{3}{8}$ in. length. Before hardening, these extensions are milled to form six equally spaced slots thus leaving six jaws. These slots, with retaining rings, which are bolted in place at the outer end of the hub extension, form the cages for the roller clutches which are part of each change gear. Taper-sided cups are countersunk in the body of the gear at the bottom of the slots to receive extensions on the ends of the rollers and thus retain them. Similar cups or fully turned grooves are also machined in the inner sides of the retaining rings for the same purpose. This construction is varied in some cases by eliminating the projections on the ends of the rollers nearest the body of the gear and counterboring with a larger cutter so that the barrel of the roller itself extends into the depression and acts as a retainer at the inner end.

Helical Gears Used

In the type shown in Fig. 1, helical gears are used throughout, therefore a bronze thrust-washer is required between each pair of gear and clutch assemblies. These washers are $\frac{1}{16}$ in thick and of the same diameter as the outside of the roller cages. The upper shaft assembly from end to end, is assembled with about 0.010-0.020-in. end play, and the bronze washers carry the end thrust while the unit is idling. When any pair of gears is engaged and transmitting power, the friction at the smaller diameter (at which the rollers are interspersed between the shaft and the gear) is sufficient to overcome the end thrust of the helical teeth, and thus eliminate the possibility of undue wear. Furthermore the helix angle is designed so that any possible resultant end thrust is directed forward on to the two-row bearing.

In operation, the engine clutch is disengaged in the usual manner and the gear-shift lever is immediately directed to the desired position, by means of intermediary gate rods and forks. This action moves a shifter collar over the hub of the proper gear. As indicated this collar is chamfered at both ends of the bore. After about $\frac{1}{8}$-in. motion of the collar, the chamfered surface contacts with the three long rollers of the roller clutch in the extension of the gear hub and forces them down into the depressions between the keys. By picking up the alternate or long rollers in this manner a distance of approximately 1 in. is allowed for the entrance of the roller into its proper depression. As the roller diameter is $\frac{3}{8}$ and the section of the cage is $\frac{1}{16}$-in. thick at this point, the rollers are forced in $\frac{1}{8}$ in. Further motion picks up the short rollers and engages them in a like manner. The motion of the collar continues until the

barrels of the rollers are completely covered and the collar is stopped.

In this position the three long rollers act as the driving members while the three short rollers take up the backlash. A clearance of 0.002-0.003 in. is allowed between the bore of the gear and the top of the splines, both of which are ground to size. As the drive is distributed at three points, the gear is centered on the driving rollers and capable of flotation to compensate for distortion, or teeth which are not entirely perfect in contour. This centering feature is an important asset of the transmission.

The rollers, shifting collars and main shaft are made of S.A.E. 2335 steel and packhardened, while all of the gears are made of oil hardening, alloy steel.

A test car has been driven for more than 1,000 miles, with but one roller in each gear. This test was extremely severe, as the allowable backlash between the shaft and respective gears set up undue conditions of impact.

The helical-gear type of transmission, in which the face of the teeth is 1 in., is illustrated in Fig. 1. The normal pitch in this case is 8 and the helix angle is 25 deg. the teeth being of standard form of 20-deg. pressure angle. All of the gears on the upper shaft assembly are cut with spirals of the same hand so that the rearward thrust of the step-down pinion is more than offset by the greater thrust of the engaged gear on the main shaft, due to the greater pressures developed through the reduction process. All end-thrust loads are transmitted to the two-row bearing at the front end.

Silence of Operation

An unusual degree of silence is obtained with the helical type of transmission, which, combined with the feature of easy shifting, made this type most attractive until it was discovered that the same features were present in the plain spur-gear type with the added advantage of greater simplicity and shorter overall length. As the faces of the helical gears are somewhat greater than required for strength, in order to obtain overlapping teeth, the width of spur gears can be reduced from $\frac{3}{4}$ to $\frac{1}{2}$ in. to carry the same power. Furthermore, the bronze thrust washers, of which there are three, can be eliminated entirely. Therefore the overall length of the transmission can be reduced in all $2\frac{3}{8}$ inches.

A spur-gear type of the same capacity as the helical-gear type is shown in Fig. 2.

At first thought it would seem that a gear width of $\frac{1}{2}$ to $\frac{3}{4}$ in. is insufficient but this is explained by the fact that no chamfers are required on the ends of the teeth to assist engagement of the gear. The average gear for a job of this size, 80 hp. maximum, is about $\frac{7}{8}$ in. wide. The effective contact face is reduced by as much as $\frac{1}{4}$ in. in some cases by the chamfers at the ends of the teeth. Naturally the width of face must vary to some extent with the size of the engine, however a transmission like that shown in Fig. 2 has shown excellent performance for more than 50,000 miles in a Stearns-Knight touring car, being subjected to all sorts of stunt driving in addition to a lot of road work in sandy country.

After ease of gear shifting, quietness is the next important factor.

The smooth running and lack of noise in the spur-gear type must be attributed to the balanced drive at three equidistant points by the three rollers of each clutch. Some clearance must be allowed between a shaft and a free-running gear. If the gear is then driven at but one point it is bound to be forced into an eccentric position. This action causes an alternating tight-and-loose condition at the point of engagement of the two gears and noise of an unpleasant nature will follow. In the case of the designs shown, the gears are centered on the three driving rollers and furthermore are allowed a sufficient amount of flotation to compensate for teeth that are a shade oversize. Normally, when driving, the gears ride on the rollers with the line of the driving thrust through the latter away from the radial direction. If any tendency toward tightness is indicated between engaging teeth, the rollers are forced down the key faces of the main shaft to a corresponding degree, and the teeth pass each other with no jamming or noise.

Backlash and Clearance

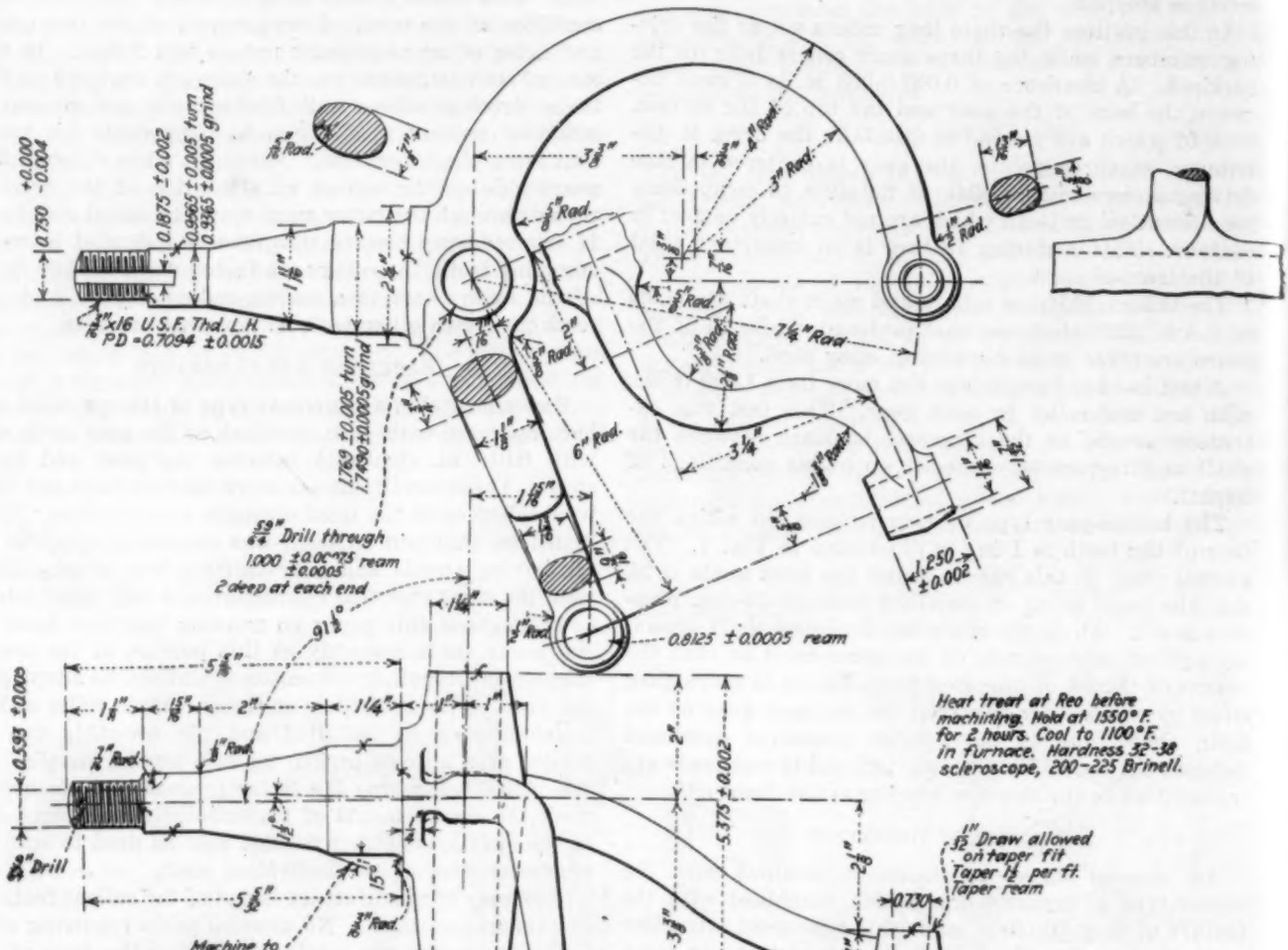
Experimentally, a spur-gear type of transmission has been operated with $\frac{1}{16}$ in. backlash at the gear teeth and with 0.010 in. clearance between the gear and main shaft. These conditions are more extreme than any that would develop in the most ordinary manufacture. Nevertheless, this transmission was satisfactorily quiet at all driving speeds and gear shifting was accomplished with the same ease that characterizes a well-fitted job.

Throughout this paper no mention has been made of the lower shaft assembly as this portion of the transmission is altogether conventional and can be adopted to the ideas of the individual engineer. Plain roller or ball bearings may be installed and the assembly can be forged as a unit or broken up into smaller details. In the helical gear type the latter process is necessary to meet the requirements of manufacturing economy, but in the spur type, either method may be used to suit the characteristics of the individual shop.

Economy of manufacture is one of the salient features of this transmission. No unusual parts requiring elaborate equipment are involved. Milling the jaws at the ends of the gear hubs is probably the most complicated operation in the whole assembly, and this operation can be performed with great accuracy and speed in an ordinary horizontal milling-machine by using three cutters on the arbor and a six-station rotary-indexing fixture. The rollers, short and long, retainer rings, shifter collar and, if desired, some of the gears can be made in automatic screw machines. No grinding is required on either the rollers or the recessed portion of the main shaft, and the shifter collars are ground inside only. To a certain extent, cutting the jaws in the gear is offset by the broaching and chamfering requirements of the usual gear layout.

One of the possibilities of this type of transmission is presented in connection with the large, city passenger-bus. Careful analyses have shown that on busy streets, the driver spends more time shifting gears and applying brakes than in driving. It has further been shown that due to the intervals required for making these shifts, the bus loses headway, proceeding by jerks, resulting in increased shock loads, wear on the parts and decreased economy in the operation of the engine.

Summing up the characteristics of this transmission, it may be stated that the desirable features of easy shifting under any conditions are combined with a high degree of quiet operation. Gear shifting is performed in the conventional manner, or if desired, the ease of shifting allows the use of any of the better known means of mechanical gear shifting, the use of which is either prohibited or confined to limited operation with the sliding-gear type of transmission.


0.730 +0.000 -0.004
0.1875 ±0.002
0.9365 ±0.005 turn 0.936 ±0.0005 grind
3/8"x16 U.S.F. Thd. L.H. PD=0.7094 ±0.0015
1.769 ±0.005 turn 1.7490±0.0005 grind
59/64" Drill through 1.000 ±0.0075 ream ±0.0005 2 deep at each end
91½°
0.8125 ±0.0005 ream
1.250 ±0.002
Heat treat at Reo before machining. Hold at 1550° F. for 2 hours. Cool to 1100° F. in furnace. Hardness 32-38 scleroscope, 200-225 Brinell.
0.593 ±0.000
5.375 ±0.002
1" Drill
1" Ream
1/2" Draw allowed on taper fit Taper ½" per ft. Taper ream
0.730
Machine to remove burr
3" Rad.
7¼" Rad.
6" Rad.

Machining Operations on Reo Steering Spindles

1—Drill 59/64-in. hole and ream to 63/64-in., two inches deep. Baker gang drill No. 121. Three spindles drilling, one reaming.

2—Rough face 1-in. hole. Barnes camel-back drill, 20-inch.

3—Countersink 1-in. hole Barnes camel-back drill, 20-inch.

4—Straighten and mill reach-rod arm. 5—Straighten and mill steering arm. Special fixture for straightening. Brown & Sharpe milling machine, No. 12.

6—Drill and ream 0.8115-in. hole. Rockford drill, 26-in. 7—Drill and taper-ream steering arm. Rockford drill, 22½-inch. 8—Finish taper-ream steering arm. Rockford drill, 22½-inch. The fixtures for drilling the bosses have a double cam arrangement for bringing the hole central. They were designed in the Reo shops.

9—Finish ream 1-in. hole. Rockford drill, 20-inch.

10—Center axle spindle for turning and grinding. Reo double-head centering machine.

11—Finish face ends of 1-in. hole. Rockford drill, 20-inch.

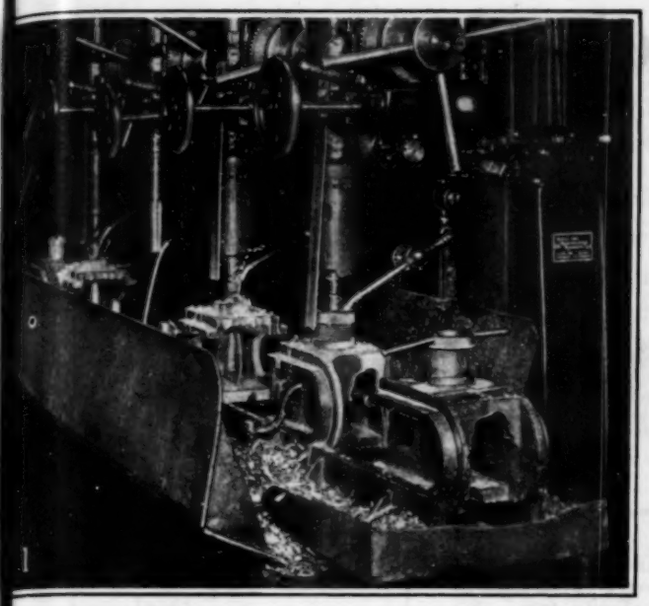
12—Turn axle-spindle complete. Le Blond lathe No. 9 multi-cut.

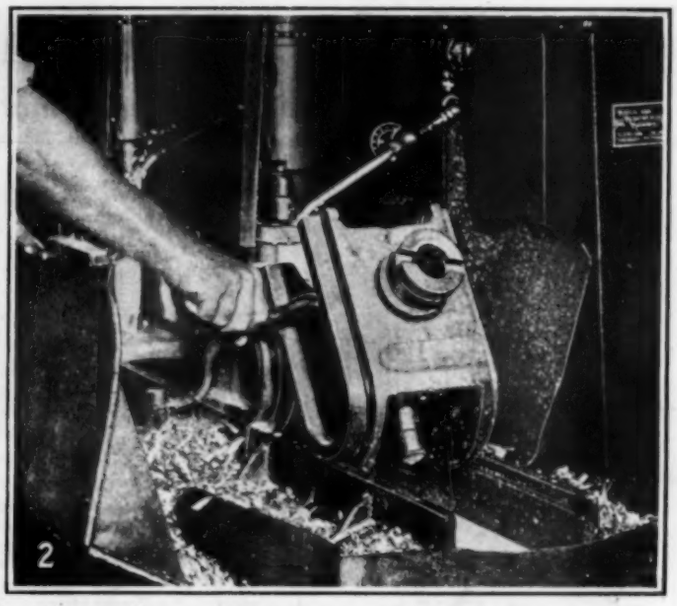
13—Grind 0.9365 and 1.7490-in. bearings. Special Norton grinder (10x15x18). Two wheels, one for each bearing.

14—Drill 9/64-in. hole for cotter key. Allen single-spindle drill 18 inch.

15—Thread. Geometric threading machine, No. 4.

16—Mill slot in thread diameter. Pratt & Whitney milling machine, No. 10.





Major Operations on the Reo Steering Spindles

Fig. 1—Drilling and reaming

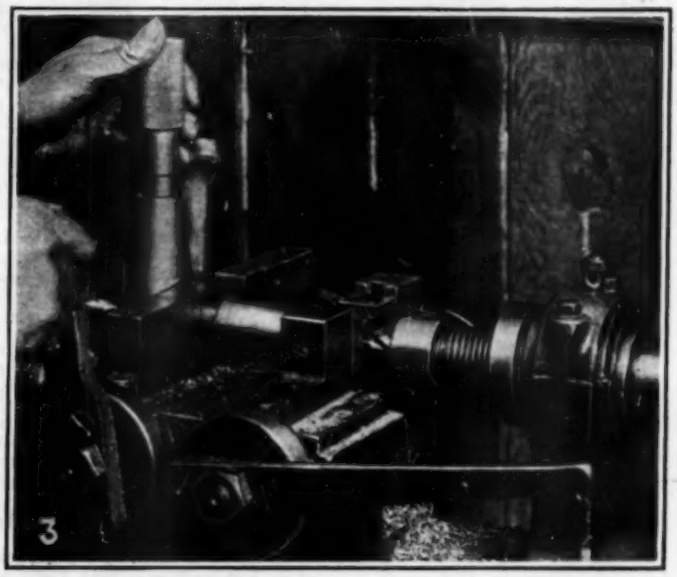
Fig. 2—The roll-over jig

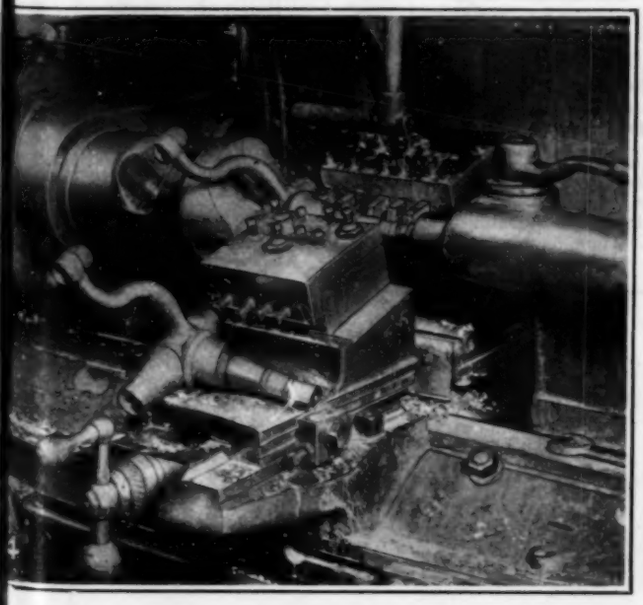
Fig. 3—Centering in special machine

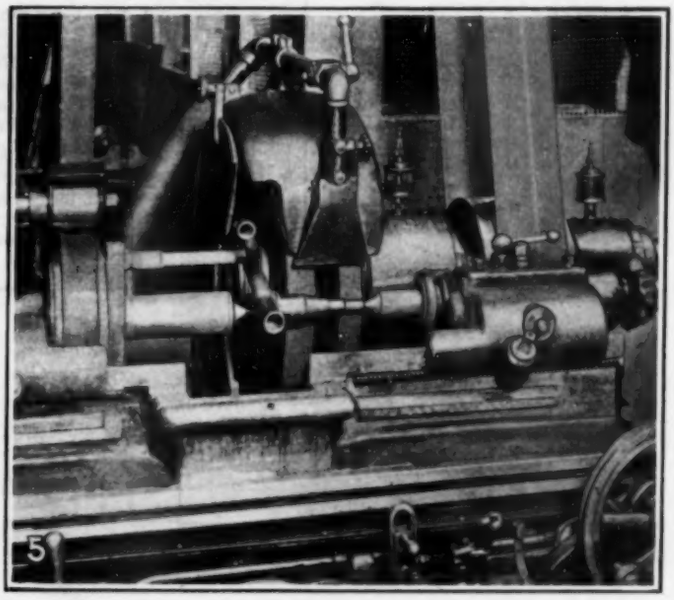
Fig. 4—Turning in Le Blond multi-cut lathe

Fig. 5—Grinding two bearings at once in Norton special grinder

Photographs by courtesy Reo Motor Car Co.







What Modern Machine Tools Are Doing

Brown & Sharpe Automatic Screw Machines

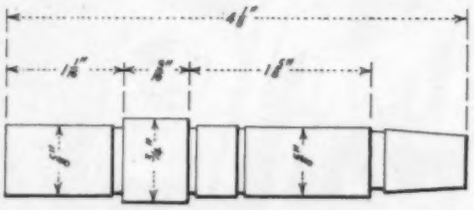


Fig. 1

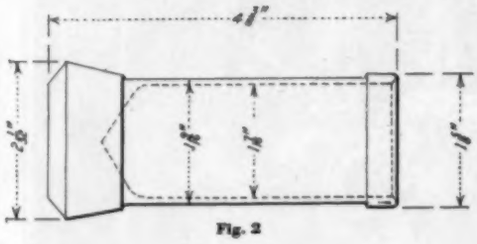


Fig. 2

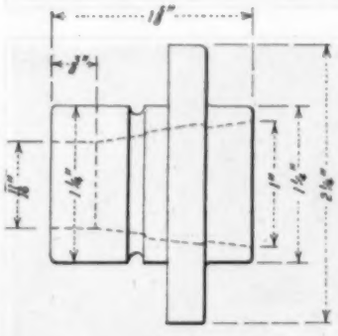


Fig. 3

Fig. 1—Shaft. No. 4 automatic. 13-16-in. M. S., hot rolled. Operations: 1—Feed stock to stop. 2—Rough turn. 3—Finish turn. 4—Turn taper. 5—Form and support. 6—Cut off. Time, 2¼ minutes.

Fig. 2—Spring-collet blank. No. 6 automatic. 2½-in. tool steel, black. Operations: 1—Feed stock to stop. 2—Rough turn. 3—Turn scale and spot. 4—Drill; form while drilling. 5—Countersink. 6—Bore. 7—Cut off. Time, 20 minutes.

Fig. 3—Wheel sleeve. No. 6 automatic. 2½-in. C.R.S. Operations: 1—Feed stock to stop. Cut off and form front end. 3—Spot. 4—Drill and form. 5—Rough-ream taper. 6—Bore recess. 7—Finish-ream taper. Time, 6 minutes.

Fig. 4—Clutch blank. No. 6 automatic. 2$\frac{7}{16}$-in. M.S., hot rolled. Operations: 1—Feed stock to stop. 2—Turn scale and spot. 3—Drill. 4—Counterbore; form while drilling. 5—Ream. 6—Cut off. Time, 4 minutes.

Fig. 5—Nut. No. 4 automatic. 1½-in. S.A.E. No. 1114 steel. Operations: 1—Feed stock to stop. 2—Spot. 3—Drill; form. 4—Counterbore. 5—Tap. 6—Cut off. Time, 110 seconds.

Fig. 6—Sprocket blank. No. 6 automatic. 2½-in. tool steel, black. Operations: 1—Feed stock to stop. 2—Turn scale. 3—Rough front-hub and spot. 4—Drill. 5—Round out; form while drilling, etc. 6—Ream. 7—Cut off. Time, 8 minutes.

Fig. 7—Worm shaft. No. 6 automatic. 1½-in. C.R.S. Operations: 1—Feed stock to stop. 2—Turn, form. 3—Turn. 4—Feed stock to stop. 5—Cut off. Time, 4 minutes.

Fig. 8—Handle. No. 6 automatic. 1½-in. C.R.S. Operations: 1—Feed stock to stop. 2—Spot. 3—Drill large hole. 4—Drill second hole. 5—Drill small hole; form while drilling. 6—Ream 3 holes. 7—Cut off. Time, 6½ minutes.

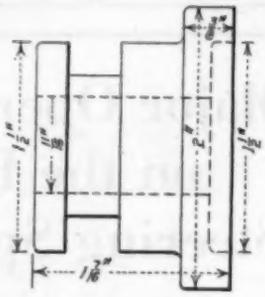


Fig. 4

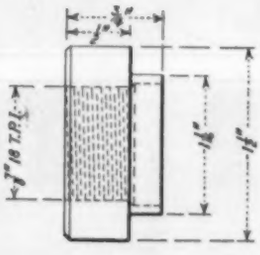


Fig. 5

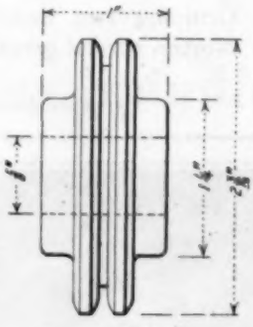


Fig. 6

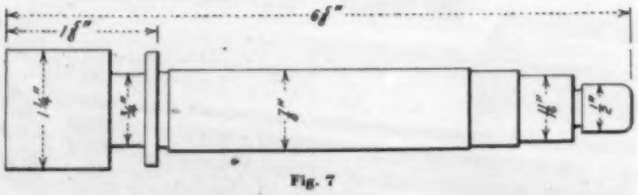


Fig. 7

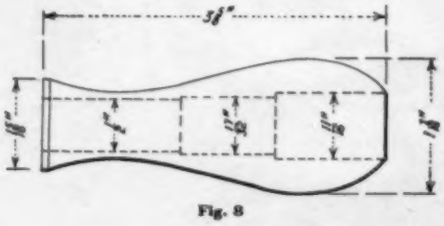


Fig. 8

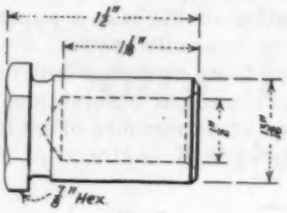


Fig. 9

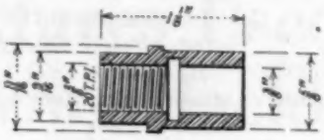


Fig. 10

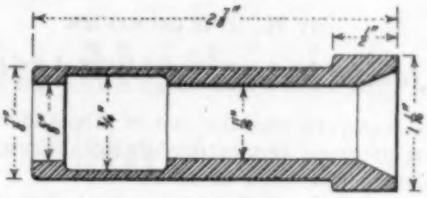


Fig. 11

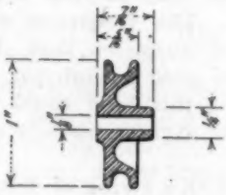


Fig. 12

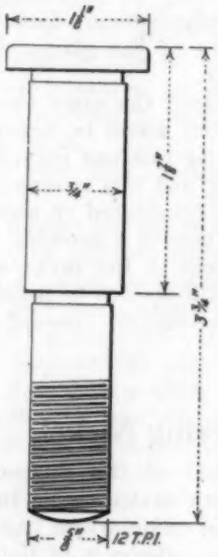


Fig. 14

Fig. 9—Hexagon sleeve. No. 2 automatic. ⅞-in. hexagon chrome-nickel steel. Operations: 1—Feed stock to stop. 2—Turn. 3—Spot. 4—Drill; form while drilling. 5—Countersink. 6—Cut off. Time, 3½ minutes.

Fig. 10—Plug. No. 2 automatic. ¾-in. M.S. Operations: 1—Feed stock to stop. 2—Spot. 3—Drill ⅝-in. hole. 4—Drill tap-hole; form while drilling. 5—Recess. 6—Tap. 7—Cut off. Time 1½ minutes

Fig. 11—Chuck sleeve. No. 4 automatic. 1⅛-in. tool steel, black. Operations: 1—Feed stock to stop. 2—Turn scale and spot. 3—Drill 1 1/16-in. hole. 4—Drill ⅛-in. hole and countersink; form while drilling. 5—Recess. 6—Bore. 7—Cut off. Time, 12 minutes.

Fig. 12—Pulley. No. 2 automatic. 1-in. C.R.S. Operations: 1—Feed stock to stop. 2—Cut off and form front end. 3—Spot. 4—Rough recess. 5—Finish. 6—Drill; form back end. 7—Ream. Time, 3 minutes.

Fig. 13—Gear stud. No. 4 automatic. 1½-in. C.R.S. Operations: 1—Feed stock to stop. 2—Rough turn. 3—Finish turn and point. 4—Form and support. 5—Thread. 6—Cut off Time, 4 minutes.

Fig. 14—Stud. No. 4 automatic. 1½-in. C.R.S. Operations: 1—Feed stock to stop. 2—Turn. 3—Turn. 4—Thread. 5—Form. 6—Cut off. Time, 2½ minutes

Fig. 15—Bevel-gear blank. No. 6 automatic. 1¼-in. Aurora steel. Operations: 1—Feed stock to stop. 2—Turn scale. 3—Cut off. 4—Spot. 5—Drill; form while drilling. 6—Ream. 7—Countersink. Time, 3 minutes.

Fig. 16—Shaft, drilled. No. 2 automatic. ⅞-in. Bessemer screw-stock. Operations: 1—Feed stock to stop. 2—Rough turn. 3—Finish turn. 4—Spot and face. 5—Drill. 6—Form and support. 7—Cut off. Time, 4 minutes.

Fig. 17—Fulcrum bushing. No. 4 automatic. 1½-in. tool steel, black. Operations: 1—Feed stock to stop. 2—Turn. 3—Turn scale and spot. 4—Drill; form while drilling. 5—Ream. 6—Cut off. Time, 7 minutes.

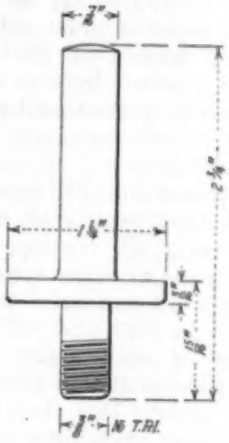


Fig. 13

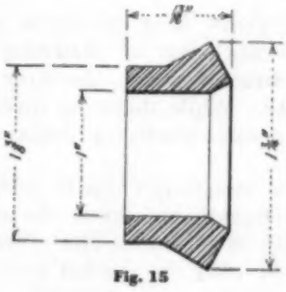


Fig. 15

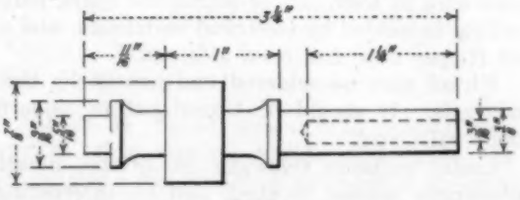


Fig. 16

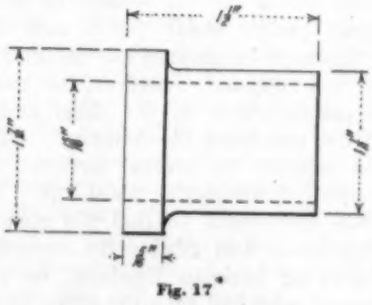


Fig. 17

Famous Machinists of History

By H. H. Manchester

James Nasmyth (1808-1890)

James Nasmyth was the son of Alexander Nasmyth, an artist of some reputation of Edinburgh, Scotland, where James was born in 1808.

He attended the Edinburgh school, but spent most of his time in a foundry which belonged to the father of one of his school friends. In the meantime his father taught him drawing, which afterwards served him frequently and well in making designs.

James left the high school when twelve years old, and soon afterwards set up a machine shop at home, where he acquired great skill in handling tools. He constructed models of the steam engine and other engines to illustrate lectures at the different mechanical institutes, and by the time he was seventeen was selling these for enough to enable him to attend classes at the university.

When he was only 19 years old, he was commissioned by the Scottish Society of Arts to build a steam carriage to carry six persons, and capable of traveling over the roads at stage speed. He accomplished this, and there were successful try-outs on the roads near Edinburgh in 1827 and 1828. It may be added that a number of such steam carriages were built by different persons at that period, but they were objected to on the ground that they frightened the horses and had no obvious advantages over the horse-drawn stage. In fact they were not as good at traveling through snow or mud.

Nasmyth was already taking an interest in astronomy, and built a telescope for his own observation in 1827.

Worked with Maudslay

Two years later Nasmyth took a position in the private workshop of Maudslay, where he carried on work directly under the eyes of that inventor and engineer. While there, he invented a shaping machine and a flexible shaft for drills, such as is still used by dentists.

After Maudslay's death in 1831, Nasmyth returned to Edinburgh, and spent the next year or so making a supply of machines and other tools for his own use. Then, in 1834, he started a shop for himself at Manchester with a capital of £63.

He soon became noted as a maker of machine tools, and forming a partnership with Holbrook and Gaskell, became one of the most important makers of tools and machinery at the time.

In 1839 there was a call for something which would forge the great paddle shaft for a new ship. For this purpose Nasmyth originated the design for a steam hammer. It was decided, however, to use a screw instead of a paddle shaft on the ship, and therefore Nasmyth did not construct the hammer. The designs, however, were shown to several persons, and when Nasmyth visited Schneider's plant at Creuzot, in France, he was astonished to find his steam hammer at work. This made him realize its importance more truly, and hurrying back to England, he patented it there. Schneider, who had seen the plans at Nasmyth's plant, had already patented it in France.

The next year, or 1843, Nasmyth patented a self-acting gear for the steam hammer, and also a steam pile-driver developed on the same principles.

Another important invention of his was a punching machine which was run by hydraulic power.

In 1856 Nasmyth retired from business, and interested himself chiefly in astronomical observations.

He died in 1890. He was an astronomer of no mean attainments, and an inventor and engineer of high rank.

Railway Shops Need Better Castings

By Frank C. Hudson

One of the obstacles in the way of the extended use of milling in the railroad shop is the all too frequent hard casting which finds its way into driving boxes, shoes, wedges and other parts. The frequency with which this occurs is ground for suspicion that steel foundries think that anything is good enough for the railway shops. For castings of this kind could not and would not be tolerated in the average manufacturing shop.

I recently saw a large planer with a string of driving boxes held up while the planer-hand was trying to remove the worst hard spots with an air tool. The planer tool had been ruined, and it was of the best high speed obtainable. A chipping chisel would not stand up on the burnt sand spots, so a tool with a sort of corrugated end was being used to break up the burnt sand and enable the work to proceed. In the meantime the work was being held up, the planer-hand's time was going on and the machine hours of the planer were ticking away like a taxicab meter.

Milling cutters would have shared the same fate as the planer tool and the cutter loss would be heavy in such a case. The answer is better castings regardless of the method used in machining, and this is especially necessary where milling is being considered on account of the investment in cutters. There is a growing tendency toward milling flat surfaces in the progressive railway shop, but its advocates will do well to insist on reasonably good castings as preliminary toward the introduction of milling.

Welding and Soldering Nickel

According to circular No. 100 of the Bureau of Standards, nickel can not be smith-welded owing to the formation of a coating of nickel oxide which can not be fluxed and which prevents the adherence of the two surfaces to be welded. On the other hand, under conditions where a reducing atmosphere may be maintained the metal may be very satisfactorily welded, as by the use of the oxyacetylene torch, the metallic-arc welding process, or by electrical-resistance welding. It is by the latter method that nickel wire is welded to iron lead-wire to form tips or points for spark plugs. Nickel tubing is welded by electrical resistance, and a speed of 69 ft. per min. has been attained.

Nickel may be soldered and brazed by the ordinary methods. It should be tinned before soldering, as is done with iron.

Under suitable reducing conditions, nickel may be plastically welded to steel, and an interesting process, invented by Doctor Fleitman about forty years ago, for producing nickel-coated steel sheets is based upon this possibility.

Some Fixtures Used in Machining Sewing-Machine Cams

By F. Osgood Hickling
Newark-on-Trent, England

The second article—The take-up lever cam—Turning and facing completed in one setting—Fixture for Milling the cam-groove—Two operations cheaper than one

THE take-up lever is the hooked arm that may be seen projecting from the side or front of the head on all lock-stitch sewing machines. It usually has an eye at the outer end through which the thread passes on its way from the reel to the needle. This lever has a rather peculiar movement in that it appears to hesitate at a certain point in its travel as if it were in doubt as to the proper direction to be taken at the moment, and this hesitation is a vital factor in the function of the machine, since it occurs at just the right instant to draw tight the stitch that has already been loosely formed in the fabric.

In Fig. 5 is shown the cam that operates this lever on a certain type of machine. This cam may be considered typical of all such cams, for, though they may vary somewhat in detail, they are all very much alike in principle.

The cam, like the needle-bar cam described in a previous article, is of cast iron and is machined all over. The figures on the drawing will give an idea of the degree of accuracy necessary to be maintained and will serve to show that as a manufacturing proposition the part requires methods of handling that are capable of producing it at reasonable cost without sacrifice of quality. The results obtained from the layout of tools here described were in every way satisfactory and the tools themselves were not unduly expensive.

Our first idea for turning the blank involved two

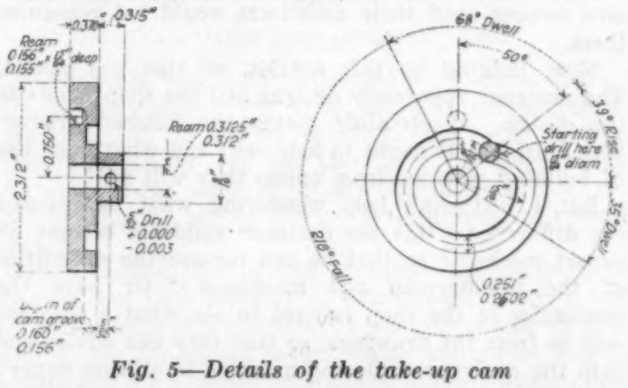


Fig. 5—Details of the take-up cam

chuckings, but as we found difficulty in maintaining concentricity by this method and also because the method tied up two capstan lathes we revised the proceedings, added one inch to the length of the hub as cast and completed the lathe work on the piece in five movements at one setting. The added length of hub was solely for the purpose of chucking, and the piece was parted off in the final movement.

The lathe movements are as follows: Rough and finish center. Drill, and turn outer diameter. Ream. Face front and back and form the $\frac{5}{16}$-in. diameter. Part off from the hub.

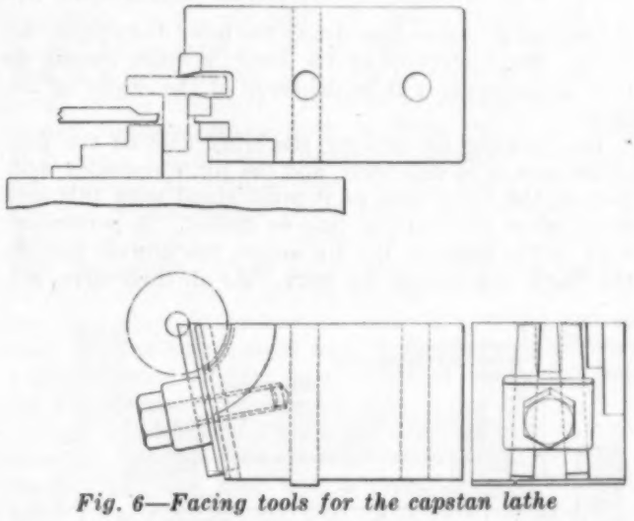


Fig. 6—Facing tools for the capstan lathe

The rough-centering tool is a short drill, specially ground, and held close to the point, as it is intended to get under the scale. It must be rigid and firmly held in order to leave a fairly true starting point for the finish-centering tool. Turning the outer diameter as the next step enables the facing tools to get a good start under the scale and greatly increases their life between grindings.

The facing tools, shown in Fig. 6, are made from standard square-section high-speed steel, ground to the requisite shape. The holder is a block, fastened to the cross-slide of the machine, having suitable ledges milled across the front end to give the tools a front clearance of 12 deg. and a side clearance of 3 deg. A clamp and bolt are provided to hold the tools in position and allow for adjustment as they are shortened by grinding.

It will be noticed that one corner of the block is cut away in order to clear the chuck jaws when the tools are brought up to their working position, but this in no way impaired its strength. The time achieved on the lathe operation is $3\frac{1}{2}$ min. per piece.

In the next operation the jig shown in Fig. 7 is used to drill the cross-hole in the hub, the blind hole on the

front face and the starting hole on the rear face for the cutter that afterwards mills the cam-groove. It consists of a body of hardened steel to which is attached a swinging clamp-lever and a swinging bolt with a rectangular head to secure the work.

An open-end slot in the clamp lever allows the bolt to be swung up into position, when a quarter-turn of the latter brings the rectangular head crosswise of the

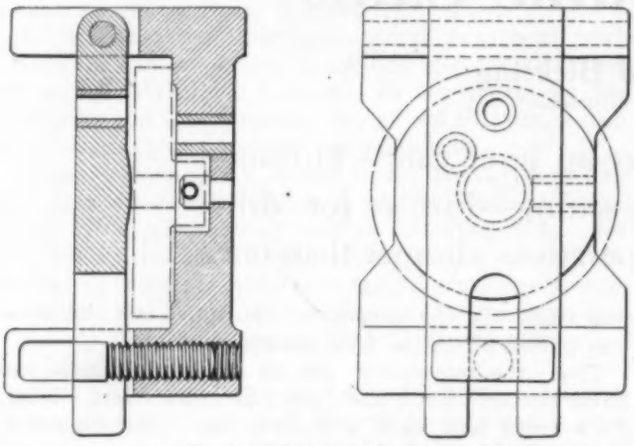


Fig. 7—Jig for drilling the three holes

slot and at the same time draws the lever down upon the work. The underface of the lever is made convex so that the pressure will be delivered at the center of the blank.

The bushing for drilling the blind hole on the face of the cam is in this lever, and the jig is provided with feet on the lever side, as it must stand with this side down when the starting hole is drilled. A permanent stud in the body of the jig enters the central hole in the blank and locates the work. As all three holes are

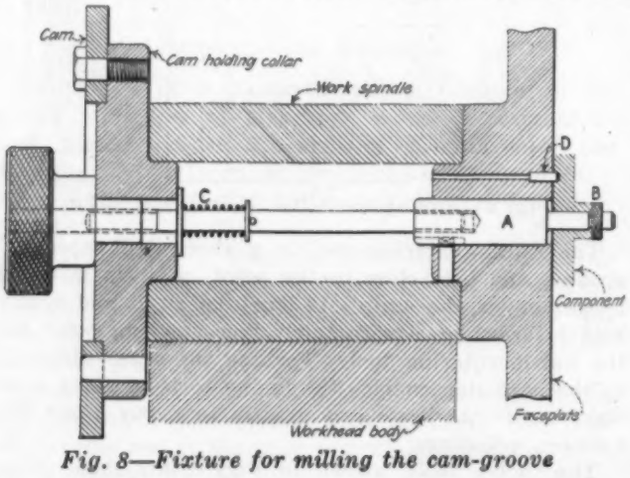


Fig. 8—Fixture for milling the cam-groove

drilled without disturbing the position of the blank in the jig, they must always remain in proper relation.

Cutting the cam-groove is the final operation and is performed in the fixture shown in Fig. 8; a P. & W. profile cam-milling machine being used to do the work. The drawbar *A* locates the blank by the central hole and at the same time draws it firmly against the faceplate. The slip-washer *B* and the coil spring *C* facilitate the movements of loading and unloading. The permanent pin, *D*, in the faceplate locates the work circumferentially with reference to the blind hole—a very important point.

Two cuts are required to mill the groove, the first one being taken with an end mill about 0.005-in. smaller in diameter than the required width of the groove, and a finish cut is then made with a cutter of exact size. In the preliminary experiments, an attempt was made to mill the groove to size with the first cutter. No starting hole was made, the cutter being sunk in endwise until the proper depth of groove was reached, but it was found that not only would the groove be invariably a trifle wider at the entering point of the cutter but that the cutter would not stand up well.

By drilling a starting hole and using two cutters, we found that because of the coarser feeds that could be employed, the time saved over sinking in the cutter at the start, and the trouble avoided by reason of the cutters standing up and requiring little resharpening, we were able to produce the pieces quite as rapidly as by the original method and a substantial saving in cutter cost was effected.

After the tools were in operation they were handled by inexperienced boys and girls, and the scrap loss was less than ten per cent.

Designing—Where Done?

BY ENTROPY

At the Steel Exposition in Boston last September, I was struck with one thing that seemed to stand out as different from any previous exhibition of machine tools. That was the apparent completeness and unity of design.

Up to this time almost all machine tools have looked as though someone designed them and then someone else redesigned and rearranged. I happen to know that in a good many cases that was the way it was done. A man in the office, draftsman by title, designer by occupation, made a drawing of what he thought would be a good machine. The drawings went to the pattern shop and, while the work was under way there, the owner came along and had this curve altered here and another there, until it looked about right to him. Then when the patterns went to the foundry, the foreman kicked, saying it would cut off all the foundry profits unless this bracket was cast separate, and that one was moved up an inch, and so on. Of course, the pattern was changed. The machine shop then took liberties which appeared only in pencil lines on its set of blueprints. The final machine looked like some of those old buildings that have been altered by successive owners until their architects would not recognize them.

Now, judging by this exhibit, all this has passed. The designer apparently designs and the shop builds to the design. It certainly makes the finished product look finished. It ought to help sell; and what's the use of building machine tools unless they will sell?

But I just can't help wondering what has caused the difference. Has the designer suddenly become an expert mechanic so that he can foresee the difficulties of the foundryman and machinist Or have the mechanics in the shop learned to see what a machine will be from the drawings, so that they can advise and help the designer while the machine is still on paper? Or has the management decided to keep each function in its own quarters and insist on the shop building what the designer says?

I hope it is the second. There has never been any good excuse for designing machinery after the manufacture was in progress.

The Spirit of Service in Technical Selling

By J. Hope

THE change in selling methods during the last decade, even the last few years, has been phenomenal, almost revolutionary. The old time commerical traveler has given way to the modern salesman. No longer does outside representation constitute a daily round of calling for orders, with samples to show customers who may evince an interest in them. The new era has brought to us the trained salesman, an expert in his business, who is concerned with much more than getting sufficient orders from week to week to bring him the amount of commission to enable him to keep his family in happy circumstances.

Sales organizations have been developed in every business in varying degrees. It is with a touch of regret that one recognizes the fact that the machine tool industry has been the follower rather than the leader.

Competition is certainly keener at the present time than heretofore. The exigencies of war conditions brought to the fore the science of producing innumerable quantities of all products, to meet an almost insatiable demand. Factories were extended and new methods cleverly developed until the productive capacity of practically every factory in the country is double or even treble the pre-war standard. These facilities still remain but the heavy demand has gone. Plants for the production of war materials have been adapted for more peaceful purposes, and firms have branched out into new lines. The problem has changed from one of producing the goods to finding a market for them. The production manager has given way to the sales and advertising manager.

In seeking an outlet for the factory's increased output, the sales organization has had to change its outlook and its methods. Production overshadows demand.

The change in outlook has involved a change in selling methods that can be tersely described as the introduction of the spirit of service into selling. But this new spirit means much. No longer does the sphere of the salesman constitute a round of calls to pick up orders—he must consider his customers' interests first and last, must look at his product in the light of its value and utility to his client.

"You Can't Fool All the," etc.

As Lincoln very aptly expressed it "You can fool all the people some of the time, some of the people all the time, but not all the people all the time," and on this fundamental idea has been built the large manufacturing establishments, themselves dependent on the development of selling science evolved from this same idea.

First orders from a new customer are much to be desired, but they are only an introduction. The sound manufacturing establishment is not maintained on first orders, but on repeat orders. The latter cost less to secure and are concrete evidence of the satisfaction that the product affords to the client in its particular sphere of use. They give solid grounds for looking forward confidently to still further orders.

This service in seeking to ever look to the customers' interests must permeate the inside staff as well as the outside salesmen, and must be evident in every quotation, in every letter, and in all printed literature dealing with the specialties in hand.

And, although the machinery and machine tool trades were not the leaders in this "spirit of service" selling, the principle underlying the same applies to these trades to a much greater extent than in the majority of trades. Engineering products are not sold for immediate consumption or use. Their useful life is extensive. They are employed to produce other articles either in whole or part. Their value to the user therefore, depends on their efficiency, and on their degree of utility over a period. Performance is the prime factor of importance, and consequently the salesman should see that he sells a machine or a tool that will perform the desired operations in the best possible manner, at a reasonable cost, and with a dependable constancy throughout the length of use that can reasonably be expected.

The Salesman's Duty

The importance of this service varies directly in proportion to the size and cost of the mechanical device which is sold. Extensive machines may have a useful life of from 10 to 20 years. They are an investment more than a mere purchase, and it devolves on the salesman to see that the proposition is a paying one from his client's point of view. The machine is bought to perform a certain duty, and it should do this in a manner and at a cost to show adequate returns to the customer. If it is to replace older machines, the new device must perform the given duty at a much quicker and, therefore, cheaper rate than the methods hitherto adopted for the same end. Not directly is this selling—it is rather a valuable aid in making a choice. The salesman must be acquainted with the possibilities of the machine, of its application; he must show how it can be applied in any particular way, and which is the best device to achieve the desired end. The salesman must seek to become an ally—not a disinterested outsider merely waiting on the doorstep for the order.

It is this selling through the spirit of service, this close co-operation between manufacturer and user, between dealer and user that is giving a more virulent aspect to our commercial life. The salesman does not call just when he knows of a possibility of an order, when he has heard that so and so are wanting such an article. He rather makes it his business to see that the machines he has already sold are giving satisfaction, to tell his customer friends of new ideas in their use, of new developments and improved features. He tells of new tools for certain jobs and seeks to keep his prospects up-to-date so far as his products are concerned.

Obviously such work cannot be carried on by the outside salesman alone, but must have its basis in the home organization. A brief study of technical literature, a thought of the higher standard of technical advertisements will soon show how this is being done. No longer do we read that a certain article is "the best on the market" or "cannot be beaten." Valuable advertising space is used to show how the product is used and why it is so valuable to the customer. Helpful instructions to show how best results can be obtained, how the article is made, why it is arranged or made in a given manner; all these things are of value to the user.

Ideas from Practical Men

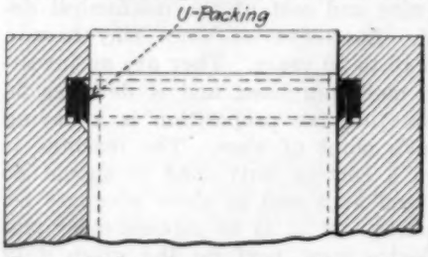
Devoted to the exchange of information on useful methods. Its scope includes all divisions of the machine building industry, from drafting room to shipping platform. The articles are made up from letters submitted from all over the world. Descriptions of methods or devices that have proved their value are carefully considered, and those published are paid for

Putting Brass Liners in Hydraulic Jacks—Discussion

By William J. Fisher, Jr.

On page 353, Vol. 61, of the *American Machinist*, Harry Ensminger in an article under the title given above, wants to know why I go to the expense of lining hydraulic cylinders with brass.

I must agree with him that lining a hydraulic cylinder with brass is expensive, but it is something that I do not do. Jacketing the ram, or moving part, is another proposition and I have found that it has cut down our costs in the matters of leather packing, time spent in truing up rams, and in loss of production from the machines quite considerably.



Brass jacketed plunger and packing

Our problems may be different from Mr. Ensminger's, but my experience with hemp packing as an expander has been unsatisfactory. The fibers separate and flow into the pipes, where they get under the pump valves and cause leaks with resultant loss of pressure, which in our work is not permissible.

I cannot see the use of the adjustable gland, as the pressure always comes on the stud-bolts, and if the gland is to be used, why was not the bottom turned to conform to the shape of the leather packing?

As may be discerned from the sketch herewith, we do not use hemp as an expander, but we *do* bevel the inside edge of the leather packing. We make the ram an easy fit in the cylinder but do not find it necessary to grind it ⁂ in less in diameter than the bore, although that practice may be permissible.

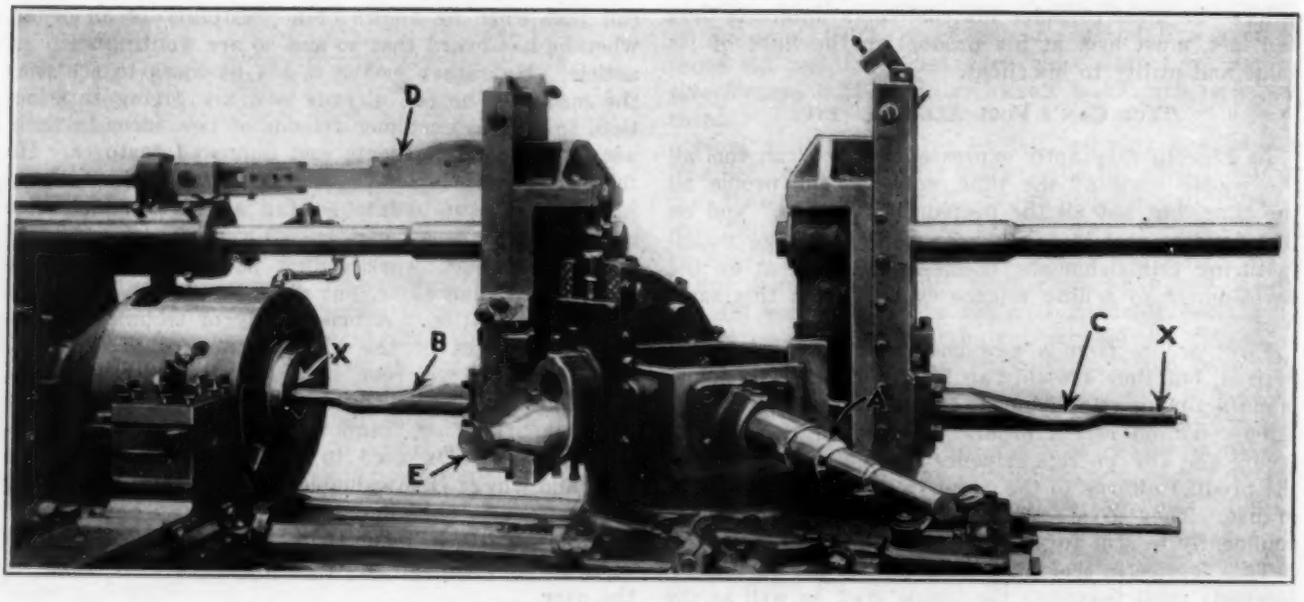
Turret Tools for Making Bottle Molds

By Chester H. Franklin

The making of bottle molds is a standard operation in the glass industry. The chuck, fixtures and set-up shown are for making the mold for a milk bottle of one-quart capacity.

The two halves of the mold are held in the large pot chuck shown. The mold is roughed out with the boring bar *A* and the special form rough-bored with the tool at *B*, while the finish forming is done by the bar in position at *C*. The bars are cut away on the upper sides to give clearance for the chips, the tools being at *X* in both bars. The former *D* controls the path of the cutting tool as it feeds into the mold. The tool cuts straight until the guide reaches the curved portion of the former, when the vertical slide carrying the tool bar is fed down to conform with *D* and so shapes the mold for the neck of the bottle. The curve at the bottom of the mold is formed by the circular tool *E*, the proper radius being on the back side, as seen by the reader.

The length of the bottle portion of the mold is 9½ in. and the diameter 3.8 in. with a tolerance of 0.0125 in. The total time, including two chuckings, is 40 min. The work is done on a Warner & Swasey No. 2-A universal turret lathe.



Machining milk-bottle molds

Method of Maintaining Gage Cocks

By Clifford H. French

Gage and water-glass cocks for locomotives are thoroughly cleaned, reground and repacked at each monthly inspection on the Santa Fé system, and more often if necessary to prevent leaks. The method of maintaining the cocks and the tools devised for the purpose are shown herewith.

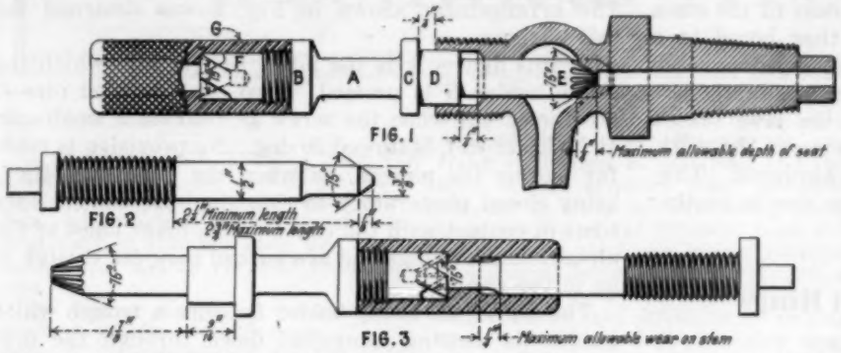


Fig. 1—Reseating gage cock. Fig 2—Details of the stem. Fig. 3—Reseating the stem

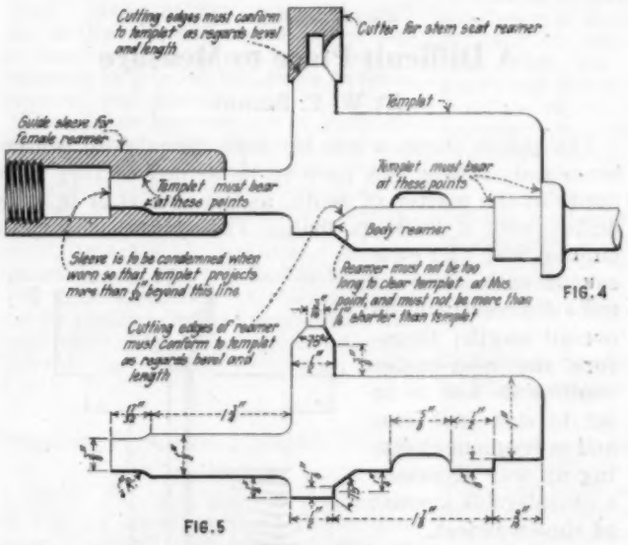

Cutting edges must conform to templet as regards bevel and length
Cutter for stem seat reamer
Templet
Guide sleeve for female reamer
Templet must bear at these points
Templet must bear at these points
Body reamer
Sleeve is to be condemned when worn so that templet projects more than ⅛" beyond this line
Reamer must not be too long to clear templet at this point, and must not be more than ⅛" shorter than templet
FIG. 4
Cutting edges of reamer must conform to templet as regards bevel and length
FIG. 5

Fig. 4—Testing bushings and reamers. Fig. 5—The templet used in testing

When the seats become so worn that they cannot be ground to a tight joint, they are reseated with the tool shown in Fig. 1. This is a combination tool for reseating both the cock body and the stem. It consists of a body, *A*, with flanges *B* and *C*. Beyond *C* is an enlarged portion which fits the packing chamber. At *E* is the reamer for reseating the body. The angle is 75 deg. At the other end of the tool is the hollow reamer *F*, with teeth at the same angle, for reseating the stem. The thread next to the flange *B*, is for holding the combined handle and guide bushing *G*. This insures the seat being square and in line with the outside of the stem.

Flange *C* limits the depth to which the seat in the cock body may be reamed. The limit is ¼ in. as indicated. The reseating of the stem is limited in the same way so as to secure sufficient room around the end of the stem to insure a clear passage for water or steam. The stem has a total reseating leeway of ½ in., as in Fig. 2. But as shown in Fig. 3, the stem can only be reseated for ¼ in. before the neck, or reduced portion, must be elongated. The small hole in the guide permits the neck to go through for ¼ in. and no more.

Gages are provided for the guide and reamer, as in Figs. 4 and 5. The gage or templet is of ⅛-in. tool steel and is hardened and tempered. All main dimensions are given, although they may vary on different roads. Details of the gage and the way in which it is used, are given in the illustrations. The system has much to commend it and a uniform or standard practice in such matters is greatly to be desired, especially on a given railroad. Nor is there any reason why such practices should not be standardized on all roads, always leaving the way open for improvements to be tried out and adopted when their superiority has been proved.

Supplementary Jaws for a Pneumatic Chuck

By R. Grant

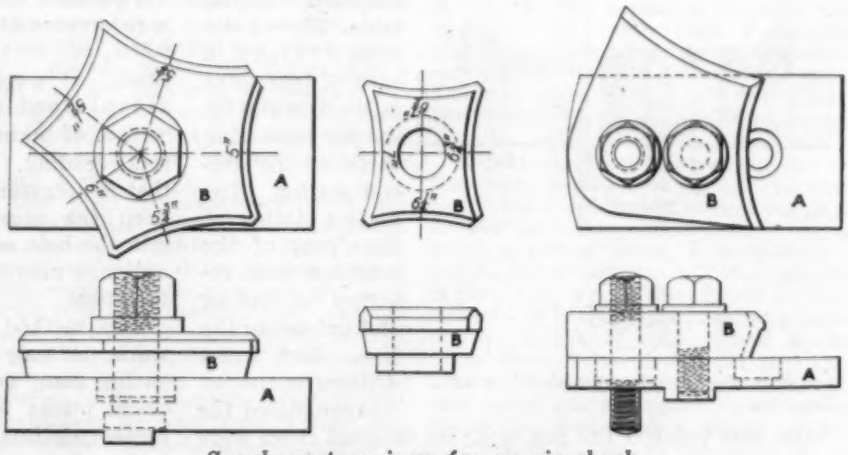
Having a 12-in. pneumatic chuck mounted on a turret lathe and a wide range of sizes of castings which had to be chucked, we developed the supplementary jaws shown by the sketches.

The jaws consist of plain-plate jaws *A* and the detachable and rotating supplementary jaws *B*.

With a set of jaws as shown at the left, any size from 5 to 6 in. can be chucked, while with the addition of a set of jaws as shown in the center, work as large as 7 in. can be held. Changing from one size to another is accomplished by loosening the nuts and rotating the supplementary jaws to the desired size.

The opening and closing movement of the air chuck being rather limited, it was thought best to make the steps in increments of ¼ in. diameter, even though this does give an overlapping.

For sizes from 7¼ to 10 in., it is necessary to make 5 sets of the supplementary jaws shown at the right,



Supplementary jaws for an air chuck

for the reason that but two sizes per set are possible, unless there is ample clearance for the jaws to project beyond the diameter of the chuck body. In our case this clearance was limited to $\frac{3}{8}$ of an inch.

When boring a set of supplementary jaws it is our practice to close the main jaws on to a collar of a size just short of the limit of the inward travel of the main jaws. This removes any possible looseness of the main jaws. The supplementary jaws are then bored to a diameter of $\frac{1}{4}$ in. less than the size stamped on each particular lobe. Being bored to a radius slightly less than that of the work to be clamped, the jaws take a better grip than if bored to the same size as the work.

The jaws are made of tool steel and hardened. They are easy and speedy to change from one size to another and have proved satisfactory in use.

A Drilling Operation on Rings

By William F. Sandmann

An electrical-motor manufacturer had a problem in the drilling of six small holes in the rings shown in the illustrations. The rings came through in large quantities and he wanted to drill them on a Natco drilling-machine if possible, but the centers of the holes were too close to permit the grouping of the spindles for drilling the six holes at one time.

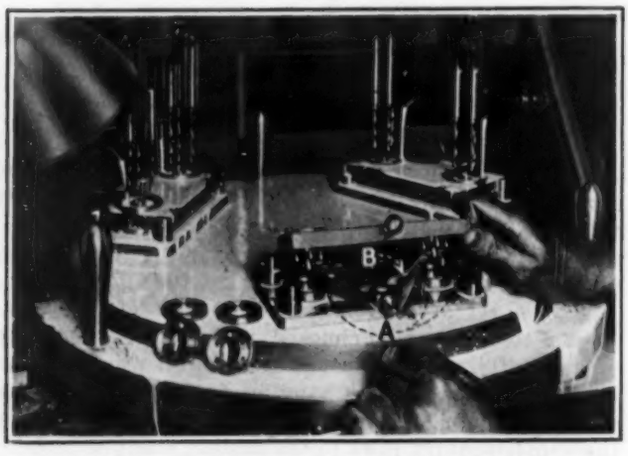


Fig. 1—Drilling fixtures on rotating table

The set-up shown in Fig. 1 was devised to use three fixtures, each holding two rings and mounted on a standard rotating table. Three holes were drilled in each of two rings at the first station and the remaining three at the second station. The third station, at the front of the machine, was reserved for loading and unloading the jigs. Each time a drilling operation was completed the table was indexed 120 deg. and two finished rings were removed.

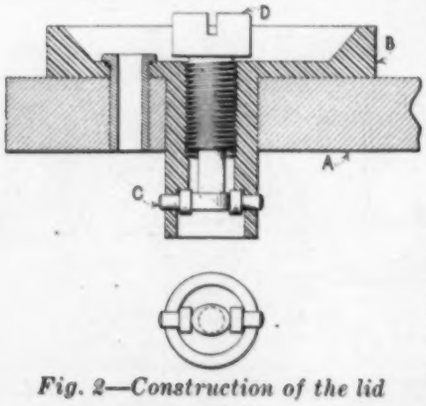


Fig. 2—Construction of the lid

The rings were located in the jigs by means of the small pins *A*, and, as the outer surfaces of the rings were ground, the pins were set to locate them very accurately. A lever *B* locked the lid of the jig.

Means had to be provided for holding the rings to prevent them from revolving between the first and second drilling operation and for holding them down. The arrangement shown in Fig. 2 was designed for this purpose.

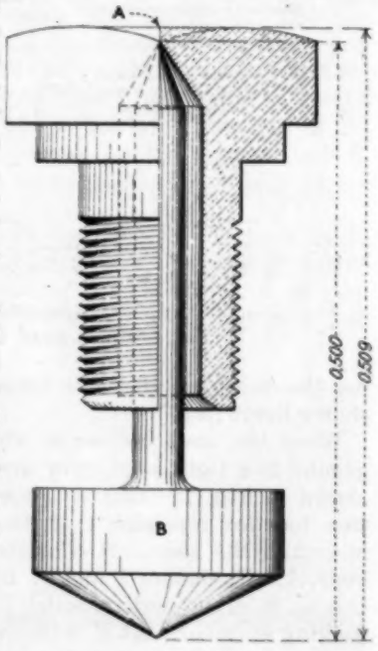
In this figure, *A* is the lid of the jig into which the clamp holder *B* is pressed. Two conical-ended pins *C* are forced out when the screw *D*, bearing a small cam at its lower end, is turned 90 deg. No provision is made for pulling the pins in, as when the lid of the jig is being closed preparatory to clamping, the conical ends come in contact with the edges of the inner holes of the already located rings and are pushed back far enough to be in the clear.

The top of the clamp holder *B* forms a trough which guides the cutting compound down through the drill bushings and directly on to the work. The drill bushings pass through clearance holes in *B* and are pressed into the lid.

A Difficult Place to Measure

By W. F. Bishop

The sketch shows a gas tip made from $\frac{3}{8}$-in. square brass rod. These tips have to be drilled to very close limits in the matter of depth, as the wall at *A* is to be drilled with a 0.006-in. drill. The action of the die on the first thread caused each piece to mike differently in the overall length; therefore the micrometer depth scale had to be set to suit each one, and as frequent checking up was necessary a considerable amount of time was lost.



Plug to measure at bottom of hole

To provide a convenient means of checking the wall thickness at the bottom of the hole the piece *B* was made from drill-rod. The points were honed until the measurement was 0.500 in. between them. It gave us a simple and quick method of taking a direct reading, as all that is necessary is to drop the steel plug into the hole and take an overall measurement with an ordinary micrometer. All that is over 0.500 in. is wall thickness.

The method can be applied to a large variety of work, not only with the result of saving time but also saving many mistakes. It will give accurate results in many places that are almost inaccessible to ordinary measuring instruments and will save the tedius manipulation of comparatively complicated and expensive tools.

Technical Abstracts

Stainless Steel

O. K. Parmiter's paper before the American Society for Steel Treating is given in full and merely noted here. This paper reviews the history and development of stainless steel and stainless iron of the 13 per cent chromium type.

The author discusses the problems involved in the manufacture of this material, its composition and the effect of various elements upon it. The heat-treatment, forging, normalizing, annealing and hardening are covered in detail. Many of the physical properties of this material are reviewed, such as heat resistance, tensile properties, corrosion resistance, resistance to acids, solutions and gases.

The author has covered in some detail the general properties of stainless steel, including the brazing and welding, cold drawing and cold rolling, its cutting properties, electrical conductivity and resistivity, magnetic properties, machining qualities, microstructure and thermal conductivity.

A brief discussion of stainless iron and its applications and possibilities are included. — *Transactions of American Society for Steel Treating*, Sept., p. 315.

Progress in Cutting Metals

C. A. Beckett, secretary of the A.S.M.E. Special Research Committee on Cutting and Forming Metals, discusses the work that has been done so far in the research problems that were presented before the A.S.M.E. on this subject. These problems are:

1—The development of a standard method for testing tool material and material to be cut.

2—The development of a standard heat-treating method.

3—The development of standard tools.

4—The development of methods for testing cutting fluids.

5—Experimental research to establish gradually the general and fundamental laws governing the relation between performance such as the various factors of toll design and adjustment, speed of work, depth of cut, nature of materials concerned and temperature and methods of lubrication and cooling.

A study of the progress made in the art of cutting metals shows that many different grades of tool steel from various manufacturers were used and that a process of elimination must be adapted for it is evident that one class of tool steel will have its special field of usefulness when applied to a material of given physical properties and chemical composition.

The subject of chip formation continues to receive considerable attention. Taylor laid out a form of tool 20 years ago which was far superior to anything of its kind at that time and that form is still accepted today as standard, but in many manufacturing plants tools are found far different from this contour and they are giving satisfaction and incidentally a different form of chip. One thing that Mr. Herbert of England has laid stress on is an adequate knowledge of the working properties of tools and of work materials that can only be obtained by testing them hot.

Various diagrams are given and a conclusion is drawn that a cutting tool is doing its most efficient work at a time when the resistance offered by a material is sufficient to raise the temperature of the tool to its maximum secondary heat-treatment temperature.

Another point brought out is that the cutting angle of the drill cannot be the same for all materials as different cutting angles will give a longer or shorter life to the drill and will also cause it to cut more efficiently on one material than on another.—*Mechanical Engineering*, Oct., p. 618.

Common Sense Psychology in Management

In this article by Edna M. Thompson, personnel supervisor of the Du Pont Fibersilk Co., she states that psychological tests were used first as an aid in employing the girls in one of the factory departments. The results were good, but because of the construction of a new plant, the work had to be given up for a time. After nine months with no tests they found they were still getting surprisingly good results from the girls employed.

The secret of success lay in a quiet, at ease, interview of at least 20 minutes conducted by the young woman who was handling the employing of the girls when having her initial talk with each candidate. She asked one simple question, namely, to describe the kind of a job she last had and by drawing out the girls and encouraging them to talk, she found out what they were capable of doing and was the better able to place them.

One point that supervisors do not always realize is that a "poor carpenter may be a good gardener." Everyone in personnel work daily makes use of such common-sense practices, but very often it is done unconsciously and because of this full value is not derived from the results. With a little mental ingenuity we may all, either in conjunction with a technical psychological department or with none, extend the use of this "common-sense psychology" and will find it both interesting and profitable.—*American Management Review*, Oct., p. 6.

Test for Shop Hiring

B. P. Campbell of the General Electric Co., West Lynn, Mass., discusses the five tests now being used in hiring men and women employees at the West Lynn Works. At the present time no one is hired there without first taking these tests and, in general, employment is given on the basis of the tests. The tests are to aid the applicant to secure the most congenial work possible.

The first test is a comparison of certain groups of numbers and the check has to be completed under a certain time in order to pass the test satisfactorily.

The test for fine instrument assembly consists of a square board containing 100 holes into each of which three brass pegs fit loosely. These pegs are placed on a table and a girl being tested picks them up, three at a time, using one hand only, and inserts them in the holes. Fine instrument assembly demands great manual dexterity. It was found that successful instrument assemblers could pass it easily. It was also found that girls who passed the test became successful instrument assemblers, and that those who failed in it found it impossible to succeed as instrument assemblers.

Has a man an engineering or designing bent? A block of wood, sawed into nine irregularly shaped pieces, is used to answer the question. When fitted together, the pieces form a rectangular cube. When first shown to the prospective engineer, designer, or draftsman, this is assembled. He is shown that it consists of 9 pieces, there being 3 pieces in each layer, horizontally and vertically. The pieces composing the block are then mixed up and the applicant is asked to re-assemble them. Two factors enter into the decisions based on this test. One is, naturally, the time element. The other is the manner in which the applicant attacks the problem. The man with a natural inclination for designing or engineering begins assembling the pieces with a definite plan in mind. He works with the evident intention of forming a rectangular cube.

Inspection of small work requires, in the main, rapid and careful observation. The inspection test consists of a drawer containing such articles as a ruler, a pad of paper, a penholder, a watch, an eraser, etc. The applicant is allowed to look at this drawer for one minute. It is then drawn under a hood and an article is either added to or taken from those already in it. The drawer is then shown to the applicant once again, and he is asked to tell what change has been made. Merely a test of observation, yet an indication as to whether or not one is likely to make a good inspector. — *Management and Administration*, Oct., p. 409.

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KENNETH H. CONDIT AND FRED H. COLVIN, *Editors*

An Unmitigated Evil

NOW that the Republican administration is assured of a working majority in both Houses of Congress it is to be hoped that immediate steps will be taken to repeal the paragraph in the present Revenue Act that permits the publication of individual and corporation tax returns. Bad as the effect is on individuals it may well be worse for corporations.

We know of one small company manufacturing a product on full automatic machines tended by low-class labor. The company was thought to be making only a moderate profit but its tax return showed a business of several hundred thousand dollars. When the workmen heard of it they promptly demanded doubled wages and closed the plant when they were refused.

There are many corporations that would pay but a small return on the capital invested even though they cleared a million dollars a year. Yet when an uneducated workman hears that the company that pays him twenty-five dollars a week cleared a sum that sounds disproportionately large he is very apt to be upset.

We have called this provision of the Revenue Act an unmitigated evil. Perhaps this term is too strong for there is at least this to be said for it: it shows the glaring defects of the tax bill. Some men of tremendous means pay relatively small taxes because they have shifted their holdings from industrial to tax-exempt securities. Everybody knew that this was being done to a certain extent but the actual figures are startling proof of Secretary Mellon's contention that the principle of the graduated surtax was defeating its own ends.

An Effective Way of Promoting Foreign Trade

WHILE still classed as an incidental and minor method of promoting foreign trade, the possibilities of future business growing out of the training here of young men of other countries, is coming to be regarded with more and more favor. There is an increasing tendency to encourage foreigners to visit the United States to familiarize themselves with our machinery and our methods of employing it, which really is a part of the same program that has as its objective the placing in American manufacturing plants and in the operation of our devices foreigners who have completed their education and are about to embark upon their careers.

There are many students from other countries who are attending our educational institutions. For the most part these students return to their homes immediately following graduation. The thought now being advanced is that arrangements should be made for these students to spend six months or a year longer in the United States in actual employment in the lines of endeavor for which they have been prepared. A part of this program also would be to induce those who have completed their education in the institutions of their own country to come to the United States to familiarize themselves with the way Americans make and handle the tools with which these graduates will have to work. The idea in this latter case is to encourage just such action as was taken by Ambassador Caetani, of his own initiative, in placing in our automobile and electrical equipment plants a number of graduate electrical and mechanical engineers who had completed their schooling in Italy.

The Department of Commerce has demonstrated the practicability of such plans through its wardship of a number of young men sent to this country by the Egyptian Government. The Egyptian authorities are so pleased with the experiment that it is probable that they will send eighty more men to this country on the same basis. H. Rahan, one of these Egyptians, for instance, has been studying the manufacture, installation and operation of Deisel and semi-Deisel engines. Two other of the Egyptians, A. K. Ahmed and A. A. Khadr are studying phases of marine engineering at American shipbuilding plants. In addition, there are twenty other Egyptians in this country who, under the guidance of various of the commodity divisions of the Department of Commerce, are getting actual experience in our plants or in the use of American-made equipment.

Experience has shown that men thus trained become the source of numerous orders when they return to take up their work at home. A further advantage accrues in that others, seeing the results obtained with American equipment, are inclined to make similar purchases.

Sowing Must Come Before Harvest

NATURE played a trick on the farmer when she compelled him to sow first and harvest his crop afterwards. How much easier it would have been for him if he could have reversed the process. Then he would be sure, at least, of having enough grain to plant.

Since Nature is doing things her own way and probably will never listen to arguments on the part of the farmer, the latter does not even complain but takes things as they come and hopes for the best.

We cannot say as much for some men in industry who still hope against hope that they can harvest first and sow afterward. And even if they do not hope they at least act as if they did. They will buy equipment when good times have come back and then, of course, they will want their harvest at once. It must be awful to have to wait a few months for a harvesting machine while the crop is drying up or gets wind blown. The man who orders his equipment when he is absolutely sure that good times have returned must be in a continuous stew waiting for the equipment which has just been ordered, wishing that he had known when good times were coming so that he might have ordered before. In the meantime he is making life miserable for the man who is to furnish him his new machine. Does it never strike men in industry that they like the farmer, must sow when no crop is in sight in order to reap the crop when harvest time comes?

Shop Equipment News

Langelier Continuous Rotary Drilling Machine

For high-production drilling of small parts, the Langelier Manufacturing Co., Arlington, R. I., is now marketing a 10-spindle, continuous, rotary drilling machine. The machine shown in the accompanying illustrations is adapted for drilling the hole in collar hexagon nuts used

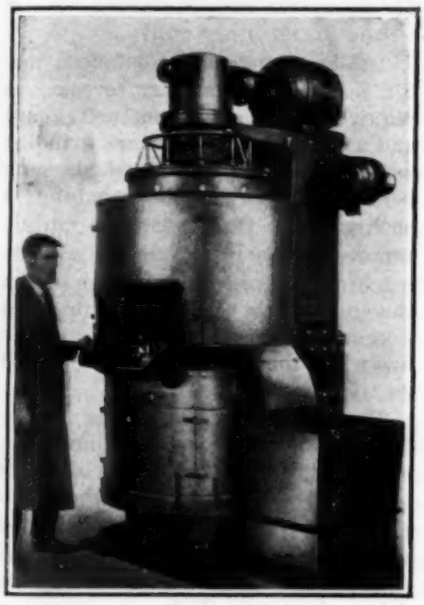


Fig. 1—Langelier Continuous Rotary Drilling Machine

on the hub of automobile disk wheels, but the machine can be arranged to drill other parts of a similar nature.

In the drilling of the nuts mentioned an output of 35 nuts per min. is obtained. The drilled hole is ¼ in. in diameter and the depth of the hole is 1 inch. High-speed drills are used and run at a speed of 1,200 r.p.m., a feed of 0.0045 in. per revolution being used.

A circular carrier, on which the ten drilling spindles, work tables, and their actuating mechanisms are mounted, revolves around a stationary post fastened to the base of the machine. The carrier is guided and supported by a well-lubricated bushing of large size and a ball thrust bearing takes the cutting thrust of the drills. At the top the carrier is held in position by a heavy trunnion that revolves in a bearing attached to a standard at the rear of the machine.

A 1-hp. induction motor is attached to the right side of the standard and drives the carrier through a reducing gear train. The motor is connected to the gear train by a belt and the lower shaft in the gear case carries a bevel pinion. The pinion meshes with a large ring bevel gear that surrounds the lower end of the carrier, and drives it at the rate of 3½ revolutions per minute.

The drilling spindles are driven through spur and bevel gearing from a 15-hp. induction motor mounted on the top of the machine. The drive gearing is enclosed and runs in oil. The drilling spindles are hardened and ground and rotate in sleeves that can be adjusted vertically and clamped in the desired drilling position. The phosphor bronze bearings in the sleeves are lubricated from drilled holes in the centers of the spindles, the oil being delivered to the tops of the spindles by pipes leading from a suitable trough.

The work tables have round trunnions that slide vertically in bearings attached to the carrier. In operation the work on the tables is fed to the drills, the feed being obtained by means of cam rolls fulcrumed in the lower end of cam blocks and engaging a stationary cam as the carrier revolves. The cam is attached to the edge of the bed under the carrier. Elevating screws between the table trunnions and the cam blocks provide vertical adjustment for the work tables.

At the beginning of the cycle the cam has a pause to permit the loading of the work into the machine. The total feeding rise of the work tables is 2¼ in., of which 1⅛ in. is the cutting feed and the remainder gives clearance for inserting the work. The work locating fixture consists of a plain circular disk fastened to the top of the work table and carrying a floating U-block that prevents the nut from turning.

A drill guide plate that carries the drill bushing is suspended on two vertical rods, these rods sliding in suitable bearings at the top of the carrier as the cam raises the work table. The position of these guides will be noted in Fig. 2, which is a

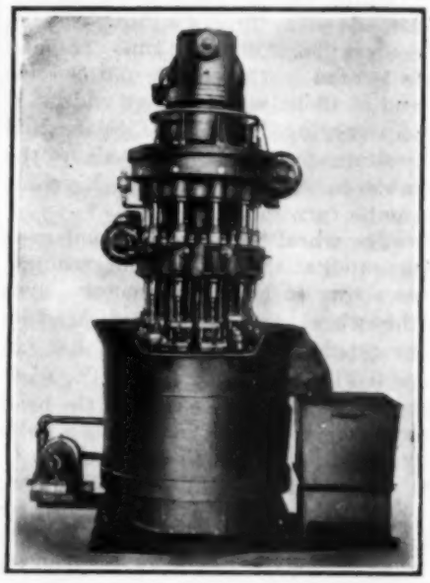


Fig. 2—Langelier drilling machine with guards removed

view of the machine with the guards removed. The rods are held down by heavy compression springs, the spring pressure serving to center the work under the drill bushing. The drilled pieces are ejected automatically from the fixture into a trough, through which they slide into a receptacle at the side of the machine.

A centrifugal pump with a capacity of 100 gal. per min. delivers cutting lubricant to the drills. The chips and the lubricant drop into a pan below the work tables, the pan having a revolving perforated bottom. A stationary blade removes the chips continuously from this pan and the lubricant passes through to a tank in the base of the machine from which it is re-circulated. The pump is driven by a 1-hp. induction motor.

The machine is completely surrounded by sheet-metal guards with an opening in front for feeding the machine.

Norton Piston Rod Grinding Machine

A machine for grinding piston rods of locomotives with the pistons in place is a recent product of the Norton Co., Worcester, Mass. It has sufficient capacity to grind the largest piston rods used on modern locomotives, having a 40-in. swing in the gap and a 16-in. swing over the table. The machine is also suitable for grinding axles, valve rods, and other long cylindrical work within its capacity.

A front view of the machine is given in Fig. 1, and it will be noted that it consists of a long bed upon which the work table is arranged to slide, carrying the work past the grinding wheel. The machine is furnished with three lengths between centers: 96, 120 and 144 in. The gap is located in the center of the table and is 19 in. wide. Other widths of gap varying from 13 to 43 in., and positioned at any point along the table to suit the work to be done, can be furnished.

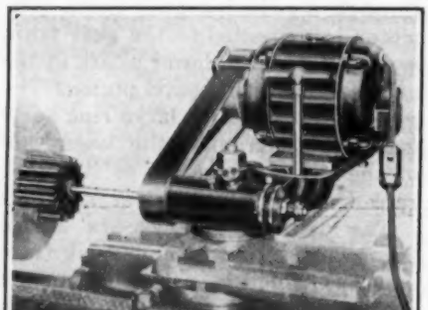
The wheel head and mechanism is mounted at the back of the machine, as shown in Fig. 2. A motor drives the wheel and the wheel head is mounted in large ways so that it can be fed in toward the work. The feeding motion is transmitted to the head by a large screw running in a half-nut that is lapped to fit the screw.

The feed is operated by an index wheel at the front of the machine by which the grinding wheel is advanced toward the work by 0.00025 in., or multiples of this amount. An index crank is provided for rapidly traversing the wheel head in changing from one diameter of work to another. Grinding lubricant is pumped from a tank in the base of the machine by a pump of the centrifugal type.

The work headstock carries a 2-hp. motor by which the work is revolved on dead centers. This motor is of the variable-speed type, so that the necessary changes in work speed can be easily and conveniently obtained.

Gilbert Portable Grinding Machine

A portable electric grinding machine that can be attached to the tool-rest of a lathe, shaper or other machine and is adaptable for either external or internal grinding, has been developed by the J. E. Gilbert Grinder Co., 216 Greenbush St., Milwaukee, Wis. The machine is



Gilbert Portable Grinding Machine

being marketed by the Service Tool, Die & Mfg. Co., 2258 Walnut St., Chicago, Ill.

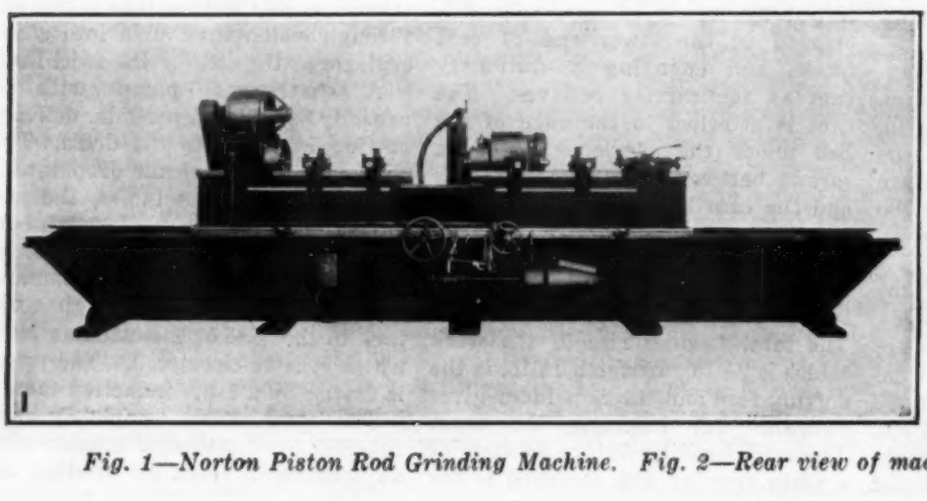
The spindle of the device is driven by a ¼-hp. electric motor through an endless canvas belt. Both the spindle housing and the motor are mounted on a cast semi-steel base that can be attached to the tool-rest of the machine to which it is applied.

The grinding wheel spindle is of oil-hardening tool steel, made in tubular form for carrying the internal spindle, and is ground both inside and outside. It runs in ball bearings at either end, the ball races being locked in the housing by internal locking nuts that are provided with felt packing to exclude the dust from grinding.

The external grinding wheel is mounted on the spindle and suitably guarded, while for internal grinding a quill is used that slides into the main spindle and is locked firmly at both ends. The internal spindle is of tool steel, ground to a close sliding fit in the main spindle. By loosening two locknuts, the quill can be shifted so that it will project only the length necessary for the depth to be ground. The pulleys furnished provide speeds of 3,000 r.p.m. for external grinding and 14,000 r.p.m. for internal work. These speeds can be varied to suit by the use of other pulleys.

A ¼-hp. dynamically-balanced motor is used, either a.c. or d.c., as required. An aluminum belt guard and a pressed steel external grinding wheel guard are furnished, each being attached to the machine in such manner that it can be quickly removed. One of the features of the machine is a device, through which the spindle can be locked by pressing a knurled stud, and thus held stationary while the nuts are being removed or tightened.

The entire machine is nicely finished and the base and guards are enameled. A 6-in. wheel for external work and ¾-, 1-, and 1½-in. wheels are furnished for internal grinding, all wheels being selected for general work. The collars for mounting the 6-in. wheel are 2½-in. in diameter, and can be seen on the spindle in the illustration. Special spindles can be furnished on order.



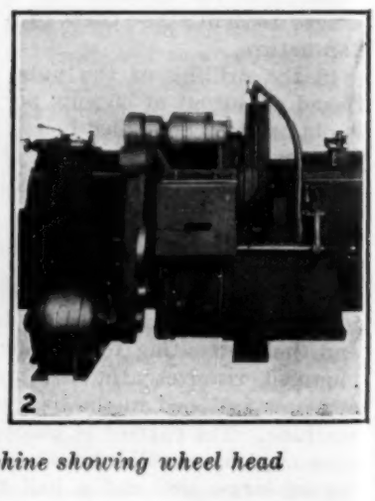


Fig. 1—Norton Piston Rod Grinding Machine. Fig. 2—Rear view of machine showing wheel head

Besly "Titan" Spiral Abrasive Disk

A spiral abrasive disk, especially adapted for grinding large surfaces and for grinding thin work that is easily heated and warped, has recently been placed on the market by Charles H. Besly & Co., 118 North Clinton St., Chicago, Ill. The abrasive portion of the disk is made up in the usual way with a cement bond, but is placed in spiral ridges with clearance spaces between them, as shown in the accompanying illustration.

Besly "Titan" Spiral Abrasive Disk

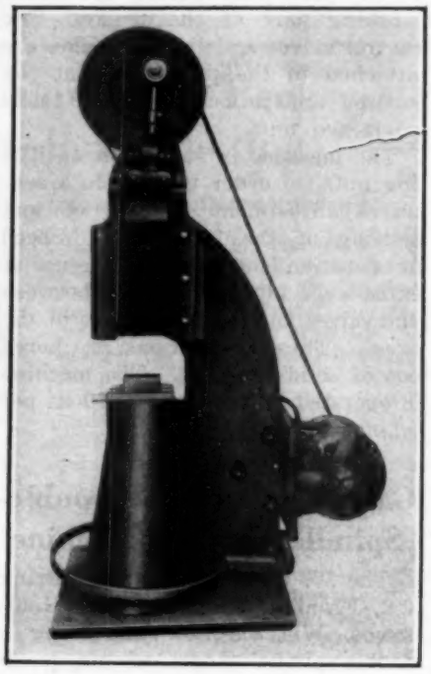
The clearance grooves run practically down to the cloth. The advantages claimed for this disk include a better cutting quality of the disk due to the shearing action of the ridges, and the opportunity provided by the clearance grooves for the escape of the grindings. The latter effect is said to lessen the heating of the work and the tendency of the wheel to glaze.

Beaudry Utility Hammer

As a general-service tool for shops where there is not enough blacksmith work to warrant any large investment in a power hammer, the Beaudry Co., Inc., Parkway at Vine St., Everett, Mass., is now marketing its low-price utility hammer. The machine is built in three sizes, in which the weights of the rams are 25, 50 and 100 lb., respectively.

The ram or hammer head is of steel and runs in heavy guides. It is adjustable on its connecting rod for varying heights above the dies. Two steel spring arms with steel rollers at the lower extremities and a helical spring at the top lift and throw the ram. With increased speed the hammer acquires increased travel and force of blow.

The hammer is started, stopped and regulated by means of a treadle extending around the base of the machine. Variation of the pressure on the treadle varies the speed and force of the hammer blow. The ram has an adjustable taper gib for taking up the wear. The machine may be worked to equal advantage from all sides, as the anvil clears the main frame casting at the side and front.



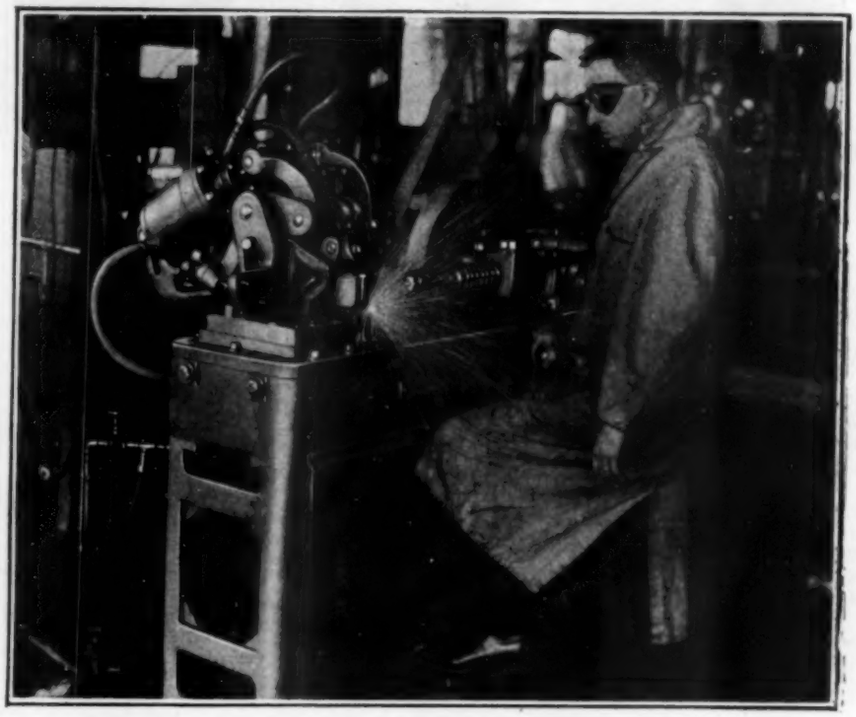
Beaudry Utility Hammer

The strokes vary from 6 in. for the smallest, to 10 in. for the large machine. The number of blows per. min. range from 400 to 300. As regularly furnished, the machines may be operated by an overhead belt or by a motor attached to the frame. Motors with capacities from 1 to 3 hp. are required.

Thomson Model 25 Automatic Butt Welder

The Model 25 automatic butt welder, recently marketed by the Thomson Electric Welding Co., Lynn, Mass., is shown in the accompanying illustration operating on steel parts having a cross-section of 0.15 sq.in. The electrical capacity of the machine is 60 kva. and it can be furnished to operate on a.c. lines with voltages from 220 to 550 and at frequencies from 25 to 60 cycles.

The machine will weld iron or steel parts with cross-sections from a minimum of 0.1 sq.in. to a maximum of 0.5 sq.in. The speed of the machine is only limited by the speed with which the operator can feed the work into the clamps. The manual labor necessary to operate the machine is small, as the clamps are actuated by air pressure and the parts are pressed together by cams. The cam mechanism is driven by belt or motor, as desired. The machine will handle flat, square, round,



Thomson Model 25 Automatic Butt Welder

or unusual, irregularly-shaped stock.

After the work is placed in the clamps, the operator steps on a pedal and the clamps immediately close. As soon as the work is gripped, the machine automatically turns on the current, starts "flashing" and completes the weld. The clamps then open and the platen returns to the starting position. The entire cycle is controlled by a single movement of the pedal.

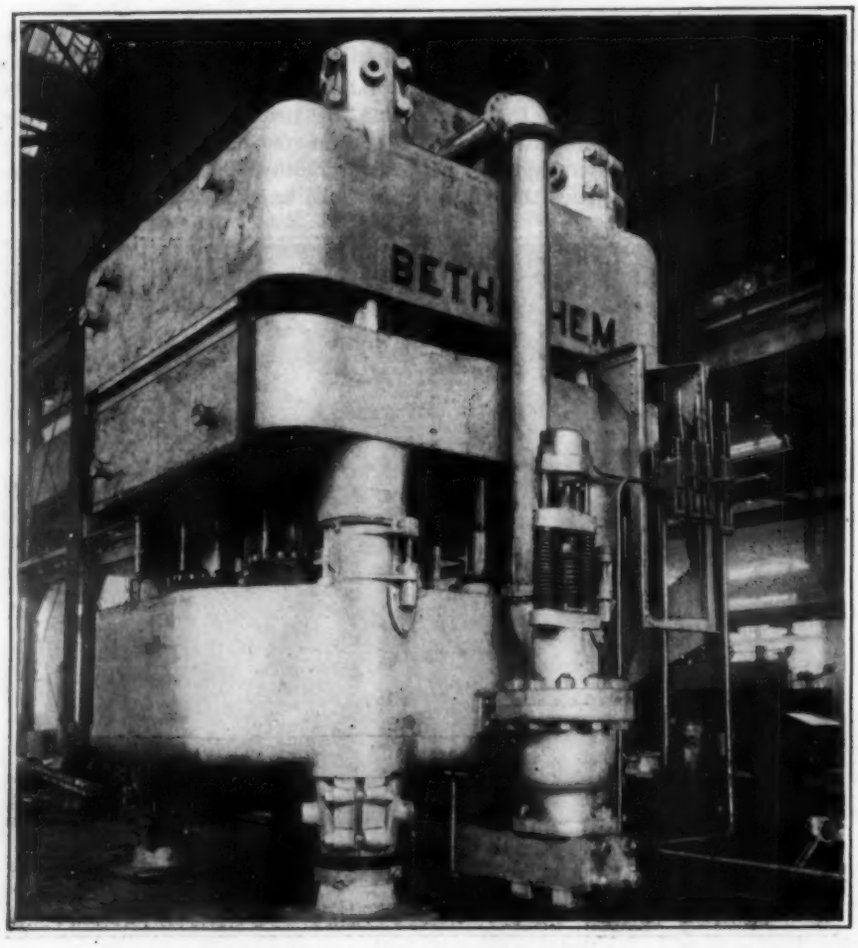
The moving parts of the machine are arranged so that they will not be damaged by the flash of the weld.

Bethlehem 3,000-Ton Hydraulic Press

An extremely large hydraulic press has recently been designed and built by the Bethlehem Steel Co., Bethlehem, Pa. The work that the press is called upon to do is exceptionally accurate and, although the working surfaces of the press are 10ft. wide and 15 ft. long, the maximum permissible deflection under a full load of 3,000 tons must not exceed 0.010 inch.

Economy in the use of high-pressure water is provided for by auxiliary lifting cylinders, in combination with a slack water tank on the top of the machine. The pressure water is used in the main cylinder of the press only during the actual working part of the stroke. The control valves and the manifolds are attached to the press, so that the entire apparatus forms a self-contained unit.

The machine is supported on lifting nuts, in order to provide a sensitive adjustment in case of any settling of the foundation. Speed of operation is obtained by the use of extra-large pipe connections between the valves and main cylinders of the press. These connections are bored out of solid forgings. The machine is operated by water at 3,000 lb. per sq.in. pressure.

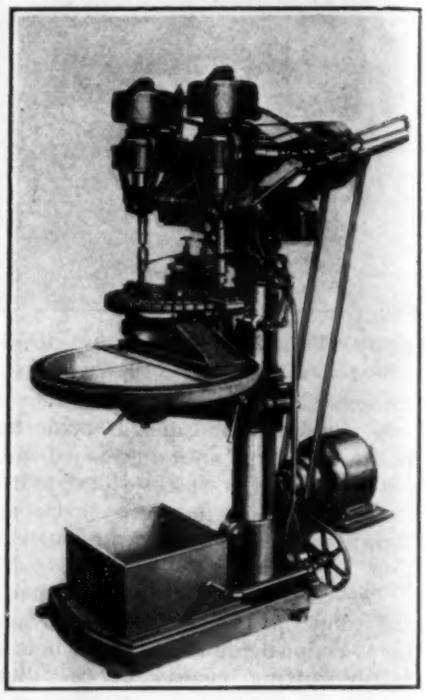


Bethlehem 3,000-Ton Hydraulic Press

Gaterman No. 4A2 Double-Spindle Tapping Machine

The W. Gaterman Manufacturing Co., Franklin and 15th Sts., Manitowoc, Wis., is now marketing a double-spindle model of its pneumatic oscillating tapping machine. The machine is designated No. 4A2 and has sufficient capacity to tap holes from ¼ to ⅝ in. in diameter. The oscillating mechanism of this line of tapping machines was described on page 496, Vol. 59, of the *American Machinist*, and the single-spindle automatic machine was described on page 151, Vol. 60.

The tapping mechanism and spindle control of the double-spindle machine is the same as that on the single-spindle machine. The double-spindle machine is fitted with an automatic rotating jig that is indexed by a small air cylinder. The jig indexes through two stations, so that both spindles work on separate pieces at the same time. If one station in the jig is not loaded by the operator, or if one tap strikes a difficult hole that takes a little more time, either one of the spindles will return and remain stationary until the other has finished its operation.



Gaterman No. 4A2-Spindle Tapping Machine

The jig shown in the accompanying illustration is used for holding pressed steel wing nuts. It is said that the production on these parts is 2,000 per hr. A larger size of this machine is also built to tap holes from ¼ to ¾ in. in diameter, and is designated No. 8A2. The machines can be arranged for either belt or motor drive, 1½- and 3-hp. motors being required.

News of the Week

Management Association Hears Progressive Talks at Cleveland Meeting

Speakers stress necessity of mutual understandings

The American Management Association held an excellent meeting in Cleveland on Nov. 13 and 14. The sessions specialized on the problems of employer representation and personnel managers to industrial relations and the principal speakers were Homer Niesz of the Commonwealth Edison Co., Dr. A. A. Mitten of the Philadelphia Rapid Transit Co., T. H. White of the American Multigraph Co. and C. Slusser of the Goodyear Tire & Rubber Co. In the evening a dinner was held at which the work of the day was summarized.

A. H. Lichty, vice-president of the Colorado Fuel & Iron Co. stated that his company employed between 10,000 and 12,000 men of fifty-four nationalities. Joint employee and employer representation was organized in October 1915 to bring about a mutual discussion of working and living conditions of the employees and to build up a confidence between the employee and employer. They found that the chief interest of every man was the fear of losing his job and that the spirit of fair play and justice did more to make a man feel secured in his employment than anything else.

The ideals of joint representation are still somewhat vague and difficult to formulate, especially to those who have not tried it intimately and practically, but they are becoming quite clear to those who are engaged in the practical working out of its problem. It is the means of conveying matters of intimate interest from employer to employee or vice-versa. Management has been so long in control that it fears to relinquish any of its privileges or authorities, but this, of course, has to be overcome in the new scheme.

No Time Lost

One interesting point raised by Mr. Lichty was that there is no interference with operations while adjustments are being made, the work of the plant going on unchecked and that the practical results have been that the employee will have better living conditions, will save more money, and, due to the continuity of employment, they are much happier. Through the eight years that the system has been in operation every question has been settled peacefully and satisfactorily at the source, and another valuable point is that the company has had no labor shortage even during the war.

Hal S. Ray, director of personnel and public relations of the Chicago, Rock Island & Pacific Ry., showed first of all the trend of industry away from the personnel and intimate contact that existed years ago between master and servant. As the plant grew the contact between the two lessened but still the idea proceeded until a natural reaction had to set in. This idea has been checked and today there is a distinct effort to bring about a more personal contact between the employer and employee and a new era is making itself manifest. In his own work intimate contact is established and maintained with all classes of railway employees and one feature is the growth of personnel work and public relations work as it is felt that public relations may be best improved by having satisfied employees.

In dealing with men the employer must have a complete willingness to put the cards on the table and this also applies to the workmen themselves. Workmen appreciate "fraternalism" but detest "paternalism."

Each class of employee is represented on the representative committee and the minutes of the meetings are carefully written out and are discussed between management and representatives. There is no welfare back of this, as welfare savors of paternalism, but as Mr. Ray stated in discussing these matters, proper "ventilation" has been substituted for "hotair."

Dr. Charles Eaton, director of industrial relations of the National Lamp Works, spoke on the topic, "Industry and the Man." He dealt with human process, called history, which is nothing more or less than progress and his definition of progress was that it meant the growing sharing of the good things of life. He cited the work of his own company where formerly an individual workman could only turn out some two or three hundred lamp bulbs a day. But today with machinery, bulbs are produced in thousands at a very much lower cost and still with one man. This means, of course, a bigger distribution of the lamp bulbs themselves and better wages to the man. On this point, Doctor Eaton stated that it should be of great interest to the employer to achieve high buying power among his workmen as this helps considerably toward improved business conditions all around.

Will Not Always Work

In discussing employee representation, Doctor Eaton sounded the thought that merely because the system would work in John Smith's plant it did not necessarily follow that it will work in your own, but that it is necessary to use common sense in adopting the system.

Education also is necessary and it should not be solely of the employee as it is just as necessary to educate the employer as to where each stand and an employee should be considered a partner in the business and a valuable one who should be educated in the conditions of the business because men will produce with all their powers when they know the conditions.

United States Census Shows Increase in Machine Tool Production

Ohio has largest proportion with Pennsylvania second

The Department of Commerce announces that, according to data collected at the biennial census of manufactures, 1923, the establishments engaged primarily in the manufacture of machine tools reported products valued at $136,871,096, an increase of 102.1 per cent as compared with 1921, the last preceding census year. This classification covers all power-driven machines for cutting or shaping metals, such as lathes, planers, drilling machines, etc.

The manufacture of machine tools in 1923 was reported from 20 states. Of these states, Ohio led with a production amounting to $36,423,371, or 26.6 per cent of the industry total; Pennsylvania was second, with $12,713,907, or 9.3 per cent; Massachusetts third, with $12,361,593, or 9 per cent; Connecticut fourth, with $11,477,374, or 8.4 per cent; Illinois fifth, with $11,307,749, or 8.3 per cent; Rhode Island sixth, with $10,393,185 or 7.6 per cent; and New York seventh, with $10,195,887, or 7.4 per cent, and the remaining 13 states reported a combined production of $31,998,030 or 23.4 per cent.

Of the 350 establishments reporting for 1923, 95 were located in Ohio, 38 in Massachusetts, 30 in Illinois, 29 in Michigan, 27 in Connecticut, 26 in Pennsylvania, 23 in New York, 18 in Wisconsin, 13 each in Indiana and New Jersey, and 10 in Rhode Island, and the remaining 28 were distributed throughout 9 other states.

"Cash Against Shipping Documents" Bad Policy, Say German Manufacturers

Germany unable to pay cash for much needed machine tools

Special Correspondence

We have again taken up the sale of American machine tools and have already obtained some results. The difficulty at present lies not only in convincing our customers of the superiority of American machine tools, but especially in the fact that we do not receive the slightest consideration from American manufacturers in regard to financial matters. It seems that the American manufacturer does not know anything about European conditions and considers himself an excellent business man in asking cash before delivery. This in reality only does him harm since it gives European manufacturers a motive for copying American machinery.

Your manufacturers do not seem to have the slightest idea about conditions in Germany and appear to think that anyone not having cash cannot be far from bankrupt. People here in Germany have sufficient security in real estate, factories, bonds, etc. Cash is scarce and banks are very careful in granting credit since they themselves have not money enough for investment even if the security is more than sufficient.

Banks generally demand security amounting to five times the amount of the loan. The fact must be taken into consideration that bills, orders, machinery in storage, etc., are not accepted as security and that first mortgages on houses will only be allowed up to one-tenth of the value. Credit is extended mostly for one month only, three months at the most. Business with America cannot be consummated in that short period of time.

Unless we write letters to your manufacturers explaining the conditions and asking them to make an exception in some particular case, the answer invariably comes in the form of a telegram, "cash against shipping documents best we can do." Really they should have said "worst we can do."

Accumulation of capital has been impossible here so far.

Speculators Have the Money

Money is mostly in the hands of speculators in exchange rates. The honest manufacturer or dealer has had no opportunity to obtain capital, since last year he had to pay out incoming capital again within a few hours after he got it in order to make quick purchases. The result is that he has on hand a large stock of machinery, but no capital. The bonds and securities bought last year are not available either just now, since most of them only sell at one-fourth their value on the market on account of the money scarcity.

The American manufacturer must realize this situation.

With pre-war methods no business of any proportion can be done except with a few machine tools that have no competition to fear.

Through his conditions for payment the American manufacturer shuts himself off from the market here for ordinary machine tools or lathes, planers, radial drills, etc.

In demanding cash before delivery he might as well say, "I object to doing business with Germany on general principles."

A short while ago we read in your publication that American manufacturers of machine tools have participated in forming an association for financing business on the Russian market. What can be done for these insolvent customers, who are forever trying to violate contracts, ought to be possible for Germany, who wants to work itself up again.

With the battle cry "cash against shipping documents" no business worth while can be done.

We are writing you about this matter from our standpoint and we believe that considerable business can be done if American manufacturers are willing to change their business methods.

Many Trade Associations Working on Conflicting Patent Cases

Conference Board outlines value of assistance to patentees

There are over one and a half million patents registered every year in the United States. But while the United States leads the world in invention the National Industrial Conference Board finds that very frequently many patents are kept from use by conflict which is avoidable.

One of the most striking features of the work now being done by trade associations, says the National Industrial Conference Board in a report which it has prepared on this subject, is the elimination of trade friction from conflicting patents. The establishment of numerous distinct legal monopolies over various devices and articles in an industry is frequently a serious obstacle to the improvement of processes and products, the board finds. One concern's patent may be "blocked" by another's and neither may be able to develop its full competitive strength, or each competitor may have some special advantage in one stage of production, but be compelled to forego the best practice in other stages. It frequently happens that while each concern benefits a little by its own exclusive rights, every concern loses more than it gains in this way by the exclusive rights represented by the numerous patents of its competitors.

Trade associations have worked out systems for interchanging patents within an industry which tend to remove these incidental handicaps which patent privileges place upon industrial progress. The most noteworthy of these plans, according to the board, is that of the National Automobile Chamber of Commerce, which has been in effect for some ten years and embraces over a thousand distinct patents. This arrangement has never been attacked in the court, and the Conference Board in its report expresses the opinion that it is in thorough accord not only with legal rules, but with sound principles of public policy.

Another of the constructive activities of trade associations described and analyzed in this comprehensive report is the sponsorship of commercial arbitration. The board points out that lasting benefits flow from educational methods that impress upon business men active in the trade a vivid realization of the costs and futility of much litigation, and of the simplicity and general advantage of arbitration in settling commercial disputes. But more significantly, trade associations afford a ready means for the establishment of the necessary instrumentalities of arbitration procedure; and it is stated that many associations, notably the Silk Association of America, have a long and excellent record of work in this field.

Report Is Comprehensive

While the activities of trade associations have not always been uniformly constructive and have oftentimes provoked the attention of the Department of Justice and the Federal Trade Commission, this report, which includes a review of this side of association experience also, concludes that on the whole the trade association movement gives promise of re-invigorating the competitive industrial system. The wholesome possibilities of properly directed and properly safeguarded business co-operation are emphasized.

Baldwins, Ltd., Will Open Montreal Plant

London cables to the effect that Baldwins, Ltd., British iron and steel manufacturers, would acquire a plant in Montreal for the purpose of supplying their Canadian trade with galvanized steel sheets direct, were confirmed by John C. Newman, manager of the Montreal headquarters of the McClary Manufacturing Co., a portion of whose plant is to be acquired for the purpose.

Worthington Gets Large Diesel Order

The Worthington Pump & Machinery Corp. has practically closed contracts aggregating substantially over $1,000,000 with several private shipping interests for installation of the recently perfected Worthington double-acting Diesel engine, says President C. P. Coleman.

Notes of Washington Activities

By Paul Wooton

Government agencies dealing with matters pertaining to machinery would be pleased were the various associations of machinery manufacturers to arrange for representation in Washington. While most of the large industries maintain offices in Washington for purposes of contact with the Federal Government, machinery manufacturers do not provide such a facility.

As the center of national legislation, of the departmental activities concerned with industry, and of many other activities of a national character, Washington has become the headquarters for many of the trade associations. In the machinery industry, however, it is recognized, for instance, that Boston is the natural point for the headquarters of the Textile Machinery Manufacturers' Association; Cleveland, the natural point for the headquarters of the Locomotive Crane Manufacturers' Association; and Cincinnati well located for the headquarters of the National Machine Tool Builders' Association. In like manner the other associations of machinery manufacturers are located at points central to the industry.

Because of the need for closer contact with this industry, particularly in matters pertaining to the promotion of foreign trade, the hope is expressed that these organizations arrange for the maintenance of a liaison organization in Washington. In this way, it is pointed out, it would be possible for the industry to maintain close contact with the Ordnance Department of the Army, the Bureau of Ordnance of the Navy, the Industrial Machinery Division of the Department of Commerce and with the committees of Congress.

Need of Representation

The advantage to the Federal agencies of having available for immediate consultation a man thoroughly acquainted with the current situation in the industries engaged in machinery manufacture is considerable, but the thought is expressed that such an arrangement would carry with it much greater advantages to the industry itself. The Government is anxious to stimulate public interest in the maximum possible use of machinery to eliminate waste of man-power. In its own activities it is a large user of machinery and is anxious to demonstrate the advantages that come from mechanical devices. Were a forward-looking and thoroughly posted representative of machinery manufacturers, as a whole, stationed in Washington, it is believed that the step would prove to be a profitable one for the industry and a great convenience to Federal officials who must maintain close contact with an activity which is taking on such rapidly increasing importance.

Reconstruction of Germany's export trade in industrial machinery is confronted by many difficulties, judging from the discussion of the subject by those interested in the industry in that country. Some contend that Germany should reduce its protective tariff, since it is, in effect, a tax on German industries that must pay the retaliatory duties which are set up in consequence by so many countries.

Fritz Reuter in discussing the subject in a recent publication, says that "the German manufacturer will be able to increase his export capacity if he can keep abreast with the progress of manufacturing technique and shop organization. To maintain export capacity by low wages can be considered a makeshift only and is justified temporarily for the sake of introducing, in the breathing spell thus gained, the greatly advanced American technique of production."

German manufacturers are given this advice from another quarter: "If we compete in foreign markets by means of sharp reductions in wages we will be accused of unfair competition, especially by the politically influential labor classes. If we compete, however, by means of quality products, resulting from advanced and highly organized manufacture, we will avoid not only this reproach but we will be able to maintain a healthy soil for our domestic market."

October Steel Trade Shows Gain

The United States Steel Corp. reported an increase in its forward business of 51,490 tons as compared with the total on the corporation's books at the end of September. The unfilled tonnage on Oct. 31 stood at 3,525,270 tons and on Sept. 30 it was 3,473,780 tons. On Oct. 31, 1923, the total was 4,672,825 tons and on Sept. 30 of that year it was 5,035,750 tons.

While the showing for October was considered favorable, the increase of 51,490 tons between Sept. 30 and Oct. 31 is less than a third of the increase of 184,000 tons that was reported between Aug. 31 and Sept. 30. In contrast with these previous periods, however, the corporation's production and shipments in October were larger than in either September or August. The month proved to be an exceptionally favorable one for operations, which was reflected in the increased shipping activity. Shipments were between 1,000,000 and 1,050,000 tons, an average of 37,000 to 38,000 tons a day for the twenty-seven working days in October, while in September these amounted to between 900,000 and 925,000 tons.

Presages a Good Finish

Members of the steel trade pointed out that the continued increase in the steel corporation's forward business since the middle of the year could be taken as a good indication of business through the remainder of the year, despite the fact that prices of steel products, which of late have been stiffening, are still considered unsatisfactory. Sufficient tonnages in the leading products are still being offered at concessions to hold down prices to a large degree, it was said, while some of the larger interests are reported to be behind a movement to raise the average level on steel products as the result of the abandonment of the Pittsburgh base.

It was also pointed out that had operations at the plants of the United States Steel Corp. been at the reduced rate they were in September, the increase in forward business between Sept. 30 and Oct. 31 probably would have equalled the increase of 184,000 tons in September. No general increase in production and shipments by the corporation is expected during the current month, and thus far incoming orders are reported slightly above those in October.

Founders Hold Annual Meeting

Elaborate plans for the annual meeting of the National Founders' Association have been made and it is expected that the interest in the meetings this year will be more pronounced than ever before. The sessions are being held at the Hotel Astor, New York City, on Nov. 19 and 20, with President William H. Barr acting as chairman.

On Wednesday morning the reports of the officers, Mr. Barr, president, A. E. McClintock, commissioner, and J. M. Taylor, secretary, will be made. These will be followed by reports of two committees, the membership committee, of which H. J. Boggis is chairman, and the industrial relations committee, of which L. W. Olson is chairman. James A. Emery, counsel for the association will be the speaker at the morning session with "Coming Shadows," his subject.

On Wednesday afternoon Jacob H. Rubin of Milwaukee, Wis., will speak on the subject, "Communism and Common Sense," J. M. Larkin, assistant to the president of the Bethlehem Steel Co., will speak on, "Industrial Relations in Industry," and Col. Alfred P. Thom, general counsel for the Association of Railway Executives has taken as his topic, "My Economic Creed."

On Thursday morning E. T. Runge of the E. T. Runge Cost Co., Cleveland, will speak on, "Foundry Cost Methods —Wise and Otherwise," and L. A. Hartley, supervisor of trade and industrial education for the state of Nebraska, will speak on, "Apprenticeship in the Foundry."

Reports of the resolutions committee and a report from the financial committee followed by the election of officers will complete the meeting.

The annual banquet will be held Wednesday evening with Harry Collins Spillman of New York City as the principal speaker.

Yearly Production of the General Electric Co.

General Electric officials expect the company to end the year with $265,000,000 of new orders, representing a decrease of about 12 per cent from last year. The final quarter of 1924 is not expected to produce more than $65,000,000 of new business.

The Business Barometer

This week's outlet in Commerce, Finance, Agriculture and Industry based on current developments

By Theodore H. Price
Editor, *Commerce and Finance, New York*

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THE psychologist is better qualified than the economist to read the riddle of last week's markets. Speculators seem to have forgotten Lord Rothschild's remark that "it is never necessary to run to the Stock Exchange," and are rushing to buy as if the present moment was the last opportunity they would ever have to invest their money.

When the quotations are analyzed it is plain that the activity is chiefly in the railroad shares. In this respect the market is entirely logical. The traffic of the railroads is large, the rates are good and the election is rightly regarded as a guarantee that there will be no adverse legislation for four years.

Therefore it is not surprising that increased dividends are expected or that it is predicted that many non-dividend stocks will soon get the dividend habit. There is in addition the talk of "consolidation" which is always a word to conjure with despite the difficulties that the Van Sweringens seem to be encountering in consummating the only combination that has thus far got beyond the rumor stage. That many others are being seriously considered is no doubt true, but they are still in embryo. As they are born they will probably stimulate the market afresh and it seems quite reasonable to assume that those railway shares that have not yet been taken up will have their turn in due time.

Some combinations are also being planned in the industrial field. A merger of baking companies that will be capitalized for some hundred of millions is announced and a smaller corporation that will absorb several ice cream companies is in the making.

But the security market now resembles a three ring circus. There is the Stock Exchange proper, the Curb Exchange and the "telephone market" where a large business in shares and bonds that is not publicly reported is carried on. It is impossible to keep up with all three of these departments, but under cover of the widely exploited activity in railroad stocks there has been no little liquidation by those experienced dealers who do their selling as well as their buying quietly.

At a slight decline large quantities of Government bonds and Treasury certificates have changed hands. The inference is that the banks are taking advantage of the buoyancy to reduce their security holdings, and this theory finds some confirmation in a bulletin issued by the National City Bank. In it Vice-President George E. Roberts expressed the belief that "the easy money situation may change very suddenly."

Meantime the President is impersonally quoted as "believing that the country can feel assured of stable conditions under which its commerce and industry can expand in a healthy fashion."

What's Doing in Industry

Machinery and machine tool centers in all parts of the United States with the exception of some New England cities reported a definite improvement in business during the past week, both inquiries and orders being received in better volume than at any time during the past two months. Some of this improvement is merely the extension of the betterment that has been noted in the machine tool field since the middle of September, but undeniably much of it was caused by post election releases of buying orders. Production in nearly all lines shows an upward trend and manufacturers state that they have orders on hand to keep them busy at the present rate for the next three months.

Most of last week's buying was done by general industrials with the automobile makers re-entering the field after an absence of some weeks. The railroads as usual were purchasers of machine tools but not to the extent that was expected. Inquiries were received in good volume from the railroad equipment makers such as locomotive builders, freight car manufacturers, and those lines dependent upon the railroads and equipment makers.

One fact is particularly pointed out by machinery and machine tool men. Total stocks in warehouses are low, so that many of the orders now being received will be filled from production.

The hectic week in Wall Street will probably be followed by a lull and some decline but authorities agree that gains made by the roads will not suffer as much as those of stocks whose prices were advanced purely by speculators and upon no foundation of fact. The line of demarkation between prosperity and inflation is very thin and veteran investors are trading with extreme caution.

Many less august authorities are giving out interviews in which they predict a boom similar to the one which followed the defeat of free silver in 1896 and lasted until 1900.

The defect in the analogy suggested is that in 1896 prices were very low and gold was at a premium of from one to two per cent because our Treasury supply was practically exhausted. Before the election money was very dear, people were thoroughly scared and industry was almost paralyzed.

No such conditions prevailed this year. Even before the recent election prices were relatively high, credit was cheap and abundant, and although some were out of work labor was fairly well employed at good wages.

It remains to be seen whether the change in sentiment can work an increase in the purchasing power of the masses at prices that already strain the incomes of the great majority. The economist will say that this is impossible. The psychologist will point out that when the impelling sentiment has been strong enough people have frequently been willing to spend their savings or go into debt rather than deny themselves the luxuries or superfluities that took their fancy.

It is too soon to say which view will prevail, but in the primary markets there is a tendency to assume that the psychologist will be right.

In the retail trade November is always a dull month and it will probably be New Year's before we know whether the ultimate consumer will buy as freely as he must if the goods that are new being made ready for him are to be moved. If he does all will be well. If not the economist will be right in maintaining that two and two makes four rather than twenty-two as some now seem disposed to think.

Of one thing at least we can be almost certain. It is that there will be no general advance in wages during the coming winter or spring. The election has made it clear that organized labor has lost its political influence for the present and the change is one of which every employer is cognizant.

In the foreign news there is little that calls for comment. In England as here confidence is returning and there are many predictions that Great Britain will soon be on a gold basis again. Sterling is accordingly higher. The political unrest in Italy, the threatened revolution in Spain and the recurrent uprisings in Brazil are regarded as unimportant manifestations of the mercurial latin temperament.

The Industrial Review

Progress of the machinery and machine-tool business in various parts of the country

THE following reports, gathered from the various machinery and machine-tool centers of the country, indicate the trend of business in these industries and what may be expected from the future:

New York

Further improvement has been noted in the machinery and machine tool market in the New York district. Most dealers are inclined to believe that this is the natural and steady improvement that has been going on for the past four weeks rather than any results of the recent election. The influence of the election, it is pointed out, will come with an increased number of inquiries first, followed by orders possibly receivable during the first part of the year. It is doubtful if the future has looked better for the machinery men in more than a year and most of the dealers are preparing for substantial increases.

Railroads were in the market during the week with the Chesapeake & Ohio and the Norfolk & Western both making good sized purchases. General industrials also bought in the New York markets with an order going to the Brady Brass Co., Jersey City, N. J., indicating an improvement in railroad equipment manufacturing.

Automobile accessories makers in the Eastern part of the country are reported busy and buying single tools.

Improvement is also reported in the used tool market after two weeks of mediocre business. Most of the inquiries and orders were received from the lower part of New England.

Exporting has not improved to any extent, but with business running at the present rate it is expected that the totals for the year will at last equal those of last year.

Canada

Judging by all the generally accepted indices of industrial progress the metalworking field in Canada is slowly but surely entering upon an era of prosperity. Important developments during the last couple of weeks that tend to bear out this contention include the decision of the Baldwin Steel Co. of Great Britain to re-open its huge Toronto plant early in the new year, the statement that the Montreal plant of Charles Walmsley & Co. is operating on full time, with much overtime work, and reports of increased carloadings of metal products.

Toronto dealers in non-ferrous metals continue to gather in good business in all lines, and lay stress on the demand for copper, tin and antimony. Warehouse iron and steel has been in fairly active demand, and pig iron has been shipped satisfactorily both for first quarter and fourth quarter delivery. The steel industry is anticipating satisfactory business for the balance of the year. A large order has been secured by the Burlington Steel Co. of Hamilton, Ontario, for structural steel to be used in the construction of a million dollar office building in Toronto.

It is considered that the return of the Conservatives to power in England will be attended with economic results of much importance to Canada—especially to the automobile industry, as it will undoubtedly mean the return of the McKenna duties, which placed a tariff of 33⅓ per cent on automobiles, when imported into Great Britain from foreign countries, but which granted a preference of one-third on imports of automobiles from the Dominions. These duties were repealed on Aug. 1, by the MacDonald government.

There has been a steady rise in the volume of railway traffic since the first week in September. Car loadings have gone up from 47,593 to 74,464 on Nov. 1. The latest employment returns made by the Dominion Bureau of Statistics show a very decided turn for the better in industrial employment.

Milwaukee

Sentiment in the metalworking trades is gradually shaping itself into a more favorable tone than has been recognizable in nearly a year, and there has been distinct improvement in opinion appraising the prospects for the coming months. The better feeling is supported by a substantial increase in inquiries for estimates and prices for foundry and machine shop products.

So far as sales of metalworking tools are concerned, the first half of November has shown a significant gain, although slight. All makers report a better inquiry, and they say that their customers no longer manifest the hesitant air which circumscribed business throughout the late spring and summer. It now appears that pre-election uncertainty causes a suspension of many plans for changes and additions to shop equipment, and that there is in prospect a general reinstatement of such projects.

The largest individual business to which the trade in this, the Chicago and other midwestern tool markets, may look forward at present is the equipment of the old Mitchell factory in Racine by the new Ajax Motors Co., a Nash interest. It is estimated that orders valued at $200,000 to $250,000 have been placed for toolroom and floor equipment, but the entire requirement will involve the purchase of machinery costing at least $750,000 to $1,000,000. There already has been selected machinery for handling engine blocks, and inquiry is in for gear cutters, grinders, automatic screw machines, and internal grinders, while the tools needed to machine all of the other metal parts of a passenger automobile remain to be acquired.

With sawmills in Wisconsin concluding the season's cut, manufacturers of lumber manufacturing equipment are getting better orders, both for replacement and additions. There is a fair call for planing mill machinery, principally for replacement, such factories now entering the busy season.

Makers as well as dealers in the metalworking equipment field look to see November turn out as equal to the best month of the present year, and feel that December should show gains.

New England

Machinery manufacturers in the Connecticut territory are waiting for the placing of new equipment orders that have been held in abeyance. Inquiry among the principal manufacturers reveals that the post election contracts promised have been scattered and few, and not up to expectations. It is, however, acknowledged that the lapse of time since election is short and perhaps ample time has not yet been allowed for orders to materialize. Confident that the business is to be had, sales managers have determined on campaigns to bring in the potential orders.

October business of machinery manufacturers was greater in volume than in September and thus far in November the business maintains the October pace. That there has been a falling off in the inquiry volume is generally conceded.

Among the chuck and die manufacturers there is a concensus of belief that the present business will be maintained for some time.

Detroit

Further evidences that the machine tool and machinery trade in Detroit and its environs is on the upgrade have shown themselves during the past week to such an extent that many leaders believe the remaining weeks of 1924 will show a material increase in business. Some contend that November and December will make up for some of the short months of the year, of which there have been several.

Throughout the Detroit industrial area and even in the other parts of Michigan, reports indicate a quickening in all lines of trade. Manufacturing plants are shoving schedules ahead and more men are being taken on by industries.

Instead of being as spotty as has been the case during the last few weeks, the trade is more widespread, dealers assert. This is due in a large measure to the increased activity in the automotive field. Many plants have

announced changes and additions to care for greater production. Figures for the first ten months show that nearly as many automobiles have been manufactured as during the banner year of 1923.

One firm whose manager counted that day good two months ago when ten inquiries reached him in a day, had more than one hundred callers and inquiries one day last week. The same holds good for many others.

The Continental Motor Corp. is showing an increase in production. For the first ten months of 1924 the figures run about twenty per cent greater than during the corresponding period last year.

Indianapolis

Business since the election has taken a turn for the better among the tool and metal machinery men in Indianapolis. Judging from reports of business conditions with plants using tools and machinery in this trade area, business will get better before the first of the year. Reports show that in all parts of the state, especially in the smaller industrial cities, business with various plants is increasing. This naturally will mean more demand for tools and machinery.

According to one leader in the trade here, Indiana appears to have exceptionally bright prospects, some of the larger plants increasing the number of employees and production. Many of the plants that have been working only four days a week have begun working five and one-half days and executives declare they have sufficient orders on hand and in prospect to maintain this schedule virtually all winter.

However, nothing appears to have any effect toward spurring the production of the local automobile plants. As a result the tool demand for these plants is far below normal. Only two factories are in production sufficiently to have any particular affect on tooling business. Most of the accessory manufacturers, however, report a fair business and the opinion is that this business will increase. Machinery trade, however, seems a little better.

Buffalo

Although there is a strong feeling that business faces a very satisfactory increase in the immediate future, there were few signs at the time of writing this letter that the pick-up expected on account of the satisfactory results of the recent election, satisfactory at least to the so-called business interest, had actually set in. In fact, most of the firms reporting today claimed they were experiencing a lighter business than two weeks ago, but this is laid to the fact that the immediate election period is always unsettling and there has not been time yet for business to recover its equilibrium.

A representative of one industrial planning organization said several manufacturers about the city had made tentative plans for enlarging plants and increasing their business, but all had been holding off to see how the election should result. He expected that some of these plans might materialize in the immediate future.

The secretary of one engineering society reported that he had had nine calls for engineers since election, one plant alone needing four or five, which was an indication of renewed confidence in the future.

The Consolidated Aircraft Corp., which has recently leased space in the Curtiss buildings, is a concern that is expected in the machine tool market before long. This firm intends moving considerable machinery here from its old plant, but will also buy some new equipment.

The Buffalo Forge Co. reports an excellent business in all its lines, which is a considerable improvement over the condition a few months ago.

The machinery sales office report a quickening of inquiries since election but none, so far as could be determined, has been closed recently. The bulk of inquiries at the present time are for small machine tools. Most of the sales made in the last two weeks have been single machines.

The crane market is very light.

Railroads Buying New Equipment

A contract for construction work involving an expenditure of $10,000,000 was awarded recently by the Illinois Central R.R.; the Atchison, Topeka & Santa Fé R.R. placed orders for new equipment and the General Railway Signal Co. announced that the Great Northern had placed orders for 400 miles of signaling.

In line with this activity is the report that equipment makers since Sept. 1 have received orders valued at $100,000,000. Another $100,000,000 has been hinging on the outcome of the election, and it is now believed that the greater portion of these orders will be placed within the next few weeks.

The contracts for $10,000,000 of work awarded by the Illinois Central include the bridges and grading on the 168-mile Edwood cut-off which will run through southern Illinois. This road when completed will give the Illinois Central another line from Kentucky to Chicago, and at the same time will materially reduce the grade, the curvature and the distance. The contracts were widely distributed, according to the advice received from Chicago.

The new equipment purchased by the Atchison, Topeka & Santa Fé will total more than $4,500,000. It includes 500 refrigerator cars, 500 gondolas and 1,000 box cars. The refrigerator and gondolas are from the American Car and Foundry Company and the 1,000 box cars from the Pullman Company. According to officials of the company, this is the last equipment order the Atchison will place this year.

Another order reported was that of the Southern Railway for 1,000 steel underframes for freight cars. The purchase was made from the Briginia Bridge and Iron Works.

Among the new inquiries for equipment was that of the Elgin, Joliet & Eastern for 500 steel underframes.

Business Items

At a meeting of the stockholders of the Brown & Sharpe Manufacturing Co., Providence, R. I., the following men were elected officers: William A. Viall, vice-president; Henry Buker, vice-president; Paul C. DeWolf, vice-president; John A. Cave, secretary; John Sharpe Chafee, assistant secretary; and Richard Viall, assistant secretary.

The Remington Typewriter Co., New York, will build a factory in Toronto, Canada, in the spring, it has been announced in Toronto.

The Cadillac Machinery Co., Detroit, Mich., has been appointed agent for the state of Michigan for products of Baker Bros., Inc., Toledo, Ohio.

The Hammond Foundry Co. has been incorporated at Hammond, Ind., with a capital stock of $60,000 to do a general foundry and machine shop business. The incorporators are A. E. Keys, William Cappel, Otto Knoerzer, J. A. Manuszak, B. M. Surdijk, S. A. Bell and J. W. Weis.

Articles of incorporation have been filed with the secretary of state by the National Engineering & Equipment Co. of Anderson, Ind. The incorporators are William N. Durbin, R. I. Van Winkle, Joseph E. Hennings, Linfield Myers and Allan Etchison. Mr. Durbin, who heads the new company, was connected with the Anderson Foundry & Machine Works for 35 years. Mr. Van Winkle was connected with the same company for a number of years. The new company will deal in power equipment and other machinery.

The Horton Steel Works, Ltd., Bridgeburg, Ontario, announces that it has taken over the plant and goodwill of the Canadian Des Moines Steel Co., Chatham, Ontario.

Personals

GEORGE E. EMMONS, vice-president in charge of manufacturing of the General Electric Co., has announced his resignation. Mr. Emmons has been identified with the industry for nearly forty years, and with the Schenectady company for the past thirty years. Mr. Emmons was made a vice-president in 1916. He will make his future home in Pasadena, Calif.

W. E. HITCHCOCK has been elected treasurer and a director of the Bellis Heat Treating Co., Branford, Conn.

HERBERT JOHNSTON has been appointed manager of the Montreal branch of the John Morrow Screw & Nut Co., Ingersoll, Ont.

GEORGE A. HENDERSON, consulting engineer with the Ordnance Department, United States Army, has resigned to go into private practice in New York City with offices located at 51 West 66th St.

WILLIAM ROBERTS, consulting production engineer of Springfield, Mass., will leave in January for Australia where he will make an industrial survey for his clients.

CHARLES PIEZ, chairman of the board of directors of the Link Belt Co., Chicago, has been nominated for president of the Illinois Manufacturers' Association.

T. F. CULLEN, formerly editor of the *Automobile Trade Journal*, has joined the organization of the Weaver Manufacturing Co., Springfield, Ill., as a sales engineer.

FRANK SMITH has been appointed district manager of the grinding machine division of the Norton Co., Worcester, Mass., with headquarters in New York City. Mr. Smith has been the company's representative in the northwest, with office in Seattle, Wash., for some time.

R. H. MCMASTER, of Toronto, Can., vice-president and director of the Steel Co. of Canada, has been appointed to the directorate of the Canadian Pacific Railway to fill the vacancy created by the death of the late Lord Shaughnessy.

AMELIUS JARVIS and M. J. HANEY, of Toronto, have resigned from the directorate of the Canadian Locomotive Co. At the annual meeting, ROBERT HOBSON was elected chairman of the board.

PROF. R. W. ANGUS, of the faculty of Applied Science and Engineering of the University of Toronto, has been elected vice-president of the American Society of Mechanical Engineers, for two years. Prof. Angus has been a member of the society for 23 years.

WILLIAM A. WHEELER, of the Paige-Detroit Motor Car Co., Detroit, has been elected a vice-president and director of the company. The election fills the vacancy on the board caused by the recent death of Sherman L. Depew. As a vice-president and member of the board of directors Mr. Wheeler will serve also as assistant to the president.

H. W. THOMPSON, formerly sales manager for Bardons & Oliver, Cleveland has been elected a vice-president of the George T. Trundle Engineering Co., Cleveland.

GLENN D. EVANS, for many years connected with the J. F. Buhr Machine Tool Co., Detroit, has again joined the Buhr organization in the capacity of chief engineer.

F. E. BROWN has been placed in charge of engineering and production of Joseph N. Smith & Co., Detroit.

CHARLES H. BROMLEY, formerly an associate editor of *Power* and for the last three years manager of the lubrication and filtration division of S. F. Bowser & Co., Inc., Fort Wayne, Ind., has been appointed manager of the engineering sales division of that company. This is a newly created position for specialization in factory sales work. He will assume the responsibilities of his new position in connection with his former duties.

Business Will Study "Human Factor"

To study the human factor, and to promote happiness, efficiency, and productivity among the workers, science and business have united in a nation-wide investigation enlisting twenty agencies from medicine to organized labor, it is announced by Alfred D. Flinn, Director of the Engineering Foundation.

The inquiry will be headed by the Personnel Research Federation established under the auspices of the Foundation and the National Research Council, and of which Dr. W. V. Bingham of the Carnegie Institute of Technology, Pittsburgh, has, it is also announced, just been appointed director. Prof. Bingham will establish headquarters at the offices of the Foundation, 29 West 39th Street, New York.

PERSONAL MANAGEMENT

This step, according to Mr. Flinn, speaking in behalf of the Federation's Board of Governors, marks a turning point in the history of personnel management in this country. Arising during the war as a serious activity in hundreds of industrial plants, and spreading to colleges, engineering practice and other channels, it has undergone the tests imposed by the whole field of industrial relations and now emerges as a definite effort to study, from the standpoint of the national welfare, the value of what has become known as "the human factor."

"Workers and their work," said Mr. Flinn, who is secretary of the Federation, will be the object of science's newest attack on a species of ignorance which, it is belived, has hindered the progress of the race.

Trade Catalogs

Chucks. The Skinner Chuck Co., New Britain, Conn. Catalog and Price List No. 38 contains half-tone illustrations of the products of this company together with a comprehensive description of the chucks and vises, dimensions and the price. The catalog is compact and easily used as a ready reference.

Thrust Bearings. The Kingsbury Machine Works, 4,320 Tackawanna St., Frankford, Philadelphia, Pa. The Kingsbury thrust bearings, vertical adjustable types, are described in a new booklet designated as Bulletin E. Tables indicating speed limits and rated thrust capacities as well as the dimensions of the products aid the reading matter and sectional drawings in fully describing the advantages claimed. This is one of five bulletins that have been issued by the company to date.

Milling Machines. The Cincinnati Milling Machine Co., Cincinnati, Ohio. "Service that Saves," is the title of an attractively made-up booklet just issued. It is a collection of milling operations taken in the plants of over fifty manufacturers in this country and abroad and with illustration and text a very interesting story is told.

Taps. The Standard Tool Co., Cleveland, Ohio. Hand taps, machine screw taps, pipe taps, shearcut taps, ground thread taps, and other products of this company are briefly described in a catalog recently issued. Tables of tolerances and other data are included in the booklet.

Pipe Threading Equipment. The Oster Manufacturing Co., Cleveland, Ohio. Die stocks, power drive machines, power machines, motors, and other products of this company are included in the catalog that has been issued recently. The catalog is indexed in such a manner that any part of the booklet is easily referred to. Illustrations, tables of dimensions, and other data are included.

Carburizing Compound Cleaner and Grader. The Brown Lynch Scott Co., Monmouth, Ill. A mailing folder has been issued by this company and sent to heat treaters in which the company's cleaning system is described in brief. An attached postal card may be sent for a more detailed description.

Ball Bearings. The New Departure Manufacturing Co., Bristol, Conn. A broadside has been sent out in which the fact that the "Around-the-World" flyers had their airships equipped with New Departure Ball Bearings is emphasized.

Hydraulic and Hydro-Pneumatic Presses. The Metalwood Manufacturing Co., Leib and Wight Sts., Detroit, Mich. The various types of presses made by the company are shown and described in a new booklet. Dimensions, weight, and the work that the presses will do are told in detail. The catalog is most complete and worth keeping in a technical library.

Milling Machines. The Ingersoll Milling Machine Co., Rockford, Ill. The Ingersoll adjustable rotary milling machine is described with six illustrations and interestingly written text, and the Ingersoll Universal rod fixtures are described with three illustrations and text in this four-page folder. A fac-simile of a letter from Robert Gaylord, vice-president of the company, makes up the first page.

Export Opportunities

The Bureau of Foreign and Domestic Commerce, Department of Commerce, Washington, D. C., has inquiries for the agencies of machinery and machine tools. Any information desired regarding these opportunities can be secured from the above address by referring to the number following each item.

Engines, hoisting and machine shop tools. Manzanilo, Mexico. Purchase. Reference No. 12,099.

Machinery accessories. Bahia, Brazil. Purchase. Reference No. 12,145.

Pumps, horse gears, and other machinery for water development. Fort Victoria, South Africa. Purchase. Reference No. 12,165.

Road making machinery. Sydney, Australia. Agency. Reference No. 12,139.

Wire bending machines. Offenbach, Germany. Purchase. Reference No. 12,164.

Forthcoming Meetings

National Founders Association. Twenty-eighth annual convention. Hotel Astor, New York City, Nov. 19 and 20. J. M. Taylor, secretary, 29 S. LaSalle St., Chicago.

American Society of Mechanical Engineers. Forty-fifth annual meeting. New York City. Dec. 1 to 4. Calvin Rice, secretary, 29 West 39th St., New York City.

National Exposition of Power and Mechanical Engineering. Grand Central Palace, New York City, Dec. 1 to 4. Charles F. Roth, 1102 Grand Central Palace Building, New York City.

Exposition of Invention. Engineering Societies Building, 29 West 39th St., New York City. Dec. 8 to 13 inc. General offices, 47 West 34th St., New York City.

American Association for the Advancement of Science. Meeting at Washington, D. C., Dec. 29, Jan. 1, 2 and 3. Burton Livingston, Smithsonian Institute, Washington, D. C.

Society of Automotive Engineers. Annual Meeting. Detroit, Mich., Jan. 20, 21, 22 and 23. C. F. Clarkson, 29 W. 39th St., New York City.

American Society for Testing Materials. Twenty-eighth annual meeting. Chalfonte-Haddon Hall Hotel, Atlantic City, N. J., June 22, 23, 24, 25 and 26. C. L. Warwick, secretary-treasurer, 1315 Spruce St., Philadelphia, Pa.

The Weekly Price Guide

Rise and Fall of the Market

Iron and Steel—Continued pig-iron demand mostly for first quarter deliveries; prices rose in Cincinnati and Philadelphia during week. Iron and steel scrap firmer. Strong upward trend in steel shapes; minimum now $2 per 100 lb., Pittsburgh, against $1.80 last week. Bar quotations are mostly at $2, with plates $1.65@$1.90 per lb. at Pittsburgh mills. Plates have advanced 5c. and shapes, 20c. per 100 lb. since Nov. 7.

Non-Ferrous Metals—With the exception of lead, the non-ferrous metals' market continues to rise. Antimony is particularly strong owing to scarcity. Tin is quiet abroad. Lead remains firm at present levels. Antimony rose 2½c., tin ½c., copper and zinc each ¼c. per lb. in New York warehouses since Nov. 7.

Linseed Oil—Raw oil (5 bbl. lots) is now $1.12 per gal., f.o.b. New York, against $1.08, one week ago.

(All prices as of Nov. 14)

IRON AND STEEL

PIG IRON—Per gross ton, f.o.b.:

CINCINNATI	
No. 2 Southern	$22.05
Northern Basic	21.77
Southern Ohio No. 2	22.27
NEW YORK—Tidewater Delivery	
Southern No. 2 (silicon 2.25@2.75)	25.10
BIRMINGHAM	
No. 2 Foundry	18.00@18.50
PHILADELPHIA	
Eastern Pa., No. 2x (silicon 2.25@2.75)	22.84
Virginia No. 2	29.75
Basic	21.75
Grey Forge	21.75
CHICAGO	
No. 2 Foundry local	20.50
No. 2 Foundry, Southern (silicon 2.25@2.75)	24.50
PITTSBURGH, including freight charge from Valley	
No. 2 Foundry	22.77
Basic	22.77
Bessemer	23.77

IRON MACHINERY CASTINGS—Cost in cents per lb. of 100 flywheels, 6-in. face x 24-in. dia., hub not cored, good quality gray iron, weight 275 lb.:

Detroit	4.75
Cleveland	4.75@5.00
Cincinnati	5.00@7.50
New York	5.00@5.50
Chicago	5.25@5.75

SHEETS—Quotations are in cents per pound in various cities from warehouse; also the mill base in large lots.

Blue Annealed	Pittsburgh Mill Base	New York	Cleveland	Chicago
No. 10	2.60@2.70	3.89	3.45	3.80
No. 12	2.70@2.80	3.94	3.50	3.95
No. 14	2.80@2.90	3.99	3.55	4.00
No. 16	3.00@3.10	4.09	3.65	4.10
Black				
Nos. 17 and 21	3.25@3.35	4.40	4.15	4.55
Nos. 22 and 24	3.30@3.40	4.45	4.20	4.55
Nos. 25 and 26	3.35@3.45	4.50	4.25	4.60
No. 28	3.40@3.50	4.60	4.35	4.50
Galvanized				
Nos. 10 and 11	3.50@3.60	4.60	....	4.60
Nos. 12 and 14	3.60@3.70	4.70	....	4.70
Nos. 17 and 21	3.90@4.00	5.00	....	5.00
Nos. 22 and 24	4.05@4.15	5.15	3.00	5.15
No. 26	4.20@4.30	5.30	4.15	5.30
No. 28	4.50@4.60	5.60	5.45	5.50

WROUGHT PIPE (Welded)—Warehouse discounts are as follows:

	New York		Cleveland		Chicago	
	Black	Galv.	Black	Galv.	Black	Galv
1 to 3 in. steel butt welded.	48%	34%	55½%	43½%	56%	43%
2½ to 6 in. steel lap welded.	44%	30%	53½%	40½%	53%	40%

Malleable fittings: Classes B and C, banded, from New York stock sell at list plus 4%; class A, plus 23%. Cast iron, standard sizes, 36% off.

SEAMLESS STEEL TUBING—Following base discounts are on 20 gauge or .035-in., round, cold-drawn tubing, ½-in. to 1-in., O.D., weighing 0.17 lb. to 0.36 lb. per ft. Cutting charge per 100 cuts, $1.50 to $1.58:

O.D. Inches	List Price per ft.	Differential Discount	O.D. Inches	List Price per ft.	Differential Discount
½	$0.09	50%	⅞	$0.16	35%
⅝	.11	45%	1	.18	31%
¾	.14	40%			

NOTE—The discounts are to be lowered by the following differentials in the case of regular .10-.20 carbon: 25,000 ft. or over, 83; 15,000 to 25,000 ft., 82; 5,000 to 15,000 ft., 81; 1,000 to 5,000 ft., 80; less than 1,000 ft., 79.

MISCELLANEOUS—Warehouse prices in cents per pound in 100-lb. lots:

	New York	Cleveland	Chicago
Open hearth spring steel (base)	4.50	6.00	4.20
Spring steel (light) (base)	7.00	6.00	6.00
Coppered Bessemer rods (base)	6.85	8.00	6.55
Hoop steel	4.49	4.35	4.15
Cold rolled strip steel	7.00	8.25	7.15
Floor plates	5.55	4.60	5.50
Cold drawn shafting or screw	4.05	3.90	3.80
Cold drawn flats, squares	4.55	4.40	4.30
Structural shapes (base)	3.34	3.20	3.10
Soft steel bars (base)	3.24	3.10	3.00
Soft steel bar shapes (base)	3.24	3.11	3.00
Soft steel bands (base)	3.99	3.20	3.65
Tank plates (base)	3.34	3.42½	3.10
Bar iron (2.90@3.00 at mill)	3.24	3.21	3.00
Tool steel	11.00	....	....
Drill rod (from list)	60%	55%	50%

Electric welding wire, New York, 5/32, 8.25c.; ¼, 7.75c.; 5/32 to ½, 7.25c. per lb.

METALS

Current Prices in Cents Per Pound

Copper, electrolytic (up to carlots), New York			14.50
Tin, 5-ton lots, New York			55.00
Lead (up to carlots), St. Louis	8.90	New York	9.50
Zinc (up to carlots), St. Louis	6.85	New York	7.62½

	New York	Cleveland	Chicago
Aluminum, 98 to 99% ingots, 1-15 ton lots	27.20	28.00	28.50
Antimony (Chinese), ton spot	15.50	14.00	10.00
Copper sheets, base	20.87½	20.87½	23.00
Copper wire, base	18.87½	19.25	21.75
Copper bars, base	20.12½	21.12½	22.50
Copper tubing, base	23.25	24.25	25.75
Brass sheets, base	17.62½	17.25	19.75
Brass tubing, base	22.00	22.75	28.25
Brass rods, base	15.37½	15.12½	17.50
Brass wire, base	18.12½	19.25	20.25
Zinc sheets (casks)	11.00	11.50	.....
Solder (½ and ½), (case lots)	39@40	34.00	30.00
Babbitt metal (83% tin)	60.00	62.50	48@52
Babbitt metal (35% tin)	28.00	19.50	23@26
Nickel (ingots) f.o.b. refinery	29.00	.....	.....
Nickel (electrolytic) f.o.b. refinery	33.00	.....	.....
Nickel (F shot) f.o.b. refinery	30.00	.....	.....

SPECIAL NICKEL AND ALLOYS—Price in cents per lb., f.o.b. Huntington, W. Va.:

Rolled nickel sheet (base)	52.00
Hot rolled rods, Grade "A" (base)	50.00
Cold drawn rods, Grade "A" (base)	58.00

Shop Materials and Supplies

METALS—Continued

Manganese nickel hot rolled rods "E"—low manganese (base) 54. 00
Manganese nickel hot rolled rods "D"—high manganese (base) 57. 00

Base price of monel metal in cents per lb., f.o.b. Huntington, W. Va.:

Shot	32. 00	Hot rolled rods (base)	40. 00
Blocks	32. 00	Cold drawn rods (base)	48. 00
Ingots	38. 00	Hot rolled sheets (base)	42. 00

OLD METALS—Dealers' purchasing prices in cents per pound:

	New York	Cleveland	Chicago
Crucible heavy copper	11.00@11. 50	10. 50	11.00
Copper, heavy, and wire	10. 75@11. 00	10. 25	10. 50
Copper, light, and bottoms	9. 50@ 9. 75	9. 50	9. 50
Heavy lead	6. 75@ 7. 00	6. 50	7. 00
Tea lead	5. 75@ 6. 00	5. 00	5. 50
Brass, heavy, yellow	7. 00@ 7. 25	6. 75	7. 00
Brass, heavy, red	8. 75@ 9. 00	8. 50	8. 50
Brass, light	6. 00@ 6. 25	5. 75	6. 00
No. 1 yellow rod turnings	7. 50@ 8. 00	7. 00	7. 00
Zinc	3. 75@ 4. 00	3. 75	3. 50

TIN PLATES—American Charcoal—Bright—Per box.

		New York	Cleveland	Chicago
"AAA" Grade:				
IC,	20x28, 112 sheets	$23. 50	$22. 85	$21. 00
"A" Grade:				
IC,	20x28, 112 sheets	19. 00	18. 80	17. 00
	Coke Plates—Primes, 20x28 in.			
100-lb.,	112 sheets	13. 00	13. 00	12 75
	Terne Plates—Small lots, 8-lb. Coating			
IC,	14x20	7. 25	6.80@6.90	6.50@6.75

MISCELLANEOUS

	New York	Cleveland	Chicago
Cotton waste, white, per lb.	$0. 14@0. 21	$0. 19	$0. 14
Cotton waste, colored, per lb.	. 09@ .14½	.18	. 10½
Wiping cloths, 13½x13½, per lb	11.00@11.25*	36. 00 per M	. 16
Wiping cloths, 13½x20½, per lb.	....	50. 00 per M	. 16
Sal soda, per 100 lb. keg	2. 25	2. 25	2. 65
Roll sulphur, per 100 lb. keg	3. 60	3. 25	3. 50
Linseed oil, per gal., 5 bbl. lots	1. 12	1. 15	1. 05
Lard cutting oil, 25% lard, per gal.	. 55	. 50	. 32
Machine lubricant, medium-bodied (50 gal. wooden bbl.), per gal.	.29	. 35	. 21
Belting—Present discounts from list in fair quantities (½ doz. rolls).			
Leather—List price, 24c. per lin. ft. per inch of width for single ply.			
Medium grade	40–2½%	30–10%	30–10%
Heavy grade	30–5%	30%	20–5–2½%
Rubber transmission, 6-in., 6 ply, $1.83 per lin. ft.			
First grade	50%	50–10%	40–10%
Second grade	50–10%	60–5%	60–5%
Abrasive materials—In sheets 9x11 in.,			
No. 1 grade, per ream of 480 sheets:			
Flint paper	$4. 86	$5. 84	$6. 48
Emery paper	10. 71	11. 00	8. 80
Emery cloth	28. 00	31. 12	29. 48
Emery disks, 6 in. dia., No. 1 grade, per 100:			
Paper	1. 49	1. 24	1. 40
Cloth	3. 38	2. 67	3 20
Fire clay, per 100 lb. bag	....	. 65	. 60
Coke, prompt furnace, Connellsville	per net ton		3. 00@3. 25
Coke, prompt foundry, Connellsville	per net ton		4.25@4. 75
White lead, dry or in oil	100 lb. kegs		New York, 15. 25
Red lead, dry	100 lb. kegs		New York, 15. 25
Red lead, in oil	100 lb. kegs		New York, 16. 75

*White, at washery.

Comparative Warehouse Prices

New York	Unit	Current Price	Four Weeks Ago	One Year Ago
Soft steel bars	per lb.	$0.0324	$0.0324	$0.0354
Cold finished shafting	per lb.	.0405	.0405	.0465
Brass rods	per lb	.1537½	.1462½	.1475
Solder (½ and ½)	per lb.	.39@.40	.37@.38	.295
Cotton waste	per lb.	.14@.21	.14@.21	10@13
Washers, cast iron (½ in.)	per 100 lb.	6. 50	6. 50	6. 50
Emery, disks, cloth, No. 1, 6 in. dia.	per 100	3. 38	3. 38	3. 38
Lard cutting oil	per gal.	.55	.55	.55
Machine oil	per gal.	29	.29	.297
Belting, leather, medium	off list	40–2½%	40–2½%	30–10%
Machine bolts up to 1x30 in.	off list	45%	50%	40–10%

SHOP SUPPLIES

Current Discounts from Standard Lists

	New York	Cleveland	Chicago
Machine Bolts:			
All sizes up to 1x30 in.	45%	60%	60%
1½ and 1½x3 in. up to 12 in	15%	.....	....
With cold punched hex. nuts up to 1 in. diam. (plus std. extra of 10%)	35%	$3. 50 net	.....
With hot pressed hex. nuts up to 1x30 in. (plus std. extra of 10%)	40%	3. 50 net	60%*
Button head bolts, with hex. nuts	10%	3. 50 net	.....
Hex. head and hex. nut bolts	10%	.....	.....
Lag screws, coach screws	45%	.....	65%
Square and hex. head cap screws	75%	75–10%	.....
Carriage bolts, up to 1 in. x 30 in.	35%	60%	55%
Bolt ends, with hot pressed nuts	45%	.....	60%
Tap bolts, hex. head, list plus	35%	.....	$4. 65
Semi-finished nuts, ⅝ and smaller	70%	.....	.....
Semi-finished nuts, ¾ and larger	65%	70%	.....
Case-hardened nuts	50%	.....	.....
Washers, cast iron, ½ in., per 100 lb. (net)	$6. 50	$4. 00	$3. 75
Washers, cast iron, ⅝ in., per 100 lb. (net)	5. 50	4. 00	3. 75
Washers, round plate, per 100 lb. Off list	1. 50	5. 00	4. 50
Nuts, hot pressed, sq., per 100 lb. Off list	1. 50	4. 00	4. 00
Nuts, hot pressed, hex., per 100 lb. Off list	1. 50	4 00	4. 00
Nuts, cold punched, sq., per 100 lb. Off list	1. 50	4. 00	4. 00
Nuts, cold punched, hex., per 100 lb. Off list	1. 50	4. 00	4. 00
Rivets:			
Rivets, ⅞ in. dia. and smaller	60%	60–10%	70%
Rivets, tinned	60%	60–10%	70%
Button heads ¾-in., ⅞-in., 1x2 in. to 5 in., per 100 lb. (net)	$5. 00	$3. 50	$3. 50
Cone heads, ditto (net)	5. 20	3. 60	3. 70
1½ to 2-in. long, all diameters, *EXTRA* per 100 lb.	0. 25	.....	0. 15
¾ in. diameter *EXTRA*	0. 35	.....	0. 15
½ in. diameter *EXTRA*	0. 75	.....	0. 50
1 in. long, and shorter *EXTRA*	0. 75	.....	0. 50
Longer than 5 in. *EXTRA*	0. 50	.....	0. 25
Less than 200 lb. *EXTRA*	0. 50	.....	0 50
Countersunk heads *EXTRA*	0. 45	.....	. .

*Square.

Machine Requirements and Industrial Construction

Machine Tools and Equipment Wanted

Calif., Los Angeles—Bd. of Education—equipment for mechanical work shops for proposed high school 6th and Francis Sts.

Calif., Los Angeles—Corondolet Fireproof Garage Co., Corondolet St.—garage equipment.

Mass., Boston—Schoolhouse Dept., City Hall, will receive bids until Nov. 25 for metal working machinery for the new East Boston High School.

Mass., Boston—Stevens Stearns Motor Car Co., 68 Dover St.—miscellaneous tools and equipment for repair and service garage at Somerville.

Mass., Brockton—M. B. Davis, 155 Main St.—miscellaneous tools and equipment for repair and service garage on Spring St.

Mass., Brockton—A. Grindin, Crescent St.—equipment for public garage.

Mass., Fall River—L. Harris, Mohican Garage, Central St.—miscellaneous tools and equipment for repair and service garage.

Mass., Jamaica Plain (Boston P. O.)—Burnett & Sherman, Inc., 47 Union Ave.—post drill, power driven, punch and shears, hand or power driven for blacksmith shop.

Mass., Marlboro—The City, School Bldg. Committee—metal and woodworking machinery for Manual Training Dept. in High School addition.

Mass., South Boston (Boston P. O.)—J. D. Marr, Old Colony Ave. and D St.—tools and equipment for public service garage.

Mass., Worcester—The City, J. B. Moss, Chrn. Building Committee — metal and woodworking machinery for new Trade School.

Mich., Marquette—F. B. Spear & Sons—5 ton electric coal crane.

Mo., St. Louis—Bd. of Education, 911 Locust St., Bldg. Dept., will receive bids until Dec. 3 for lathes for machine shop and equipment for machine, auto, woodturning, forge and moulding shops for the Beaumont High School.

Mo., St. Louis—L. Liebel, 2609 Caroline St.—lathe, 6 ft. bed, screw cutting. (new or used)

N. Y., Buffalo—Auto Frame Springs Co. Inc., 376 North Oak St.—equipment for auto spring repair shop.

N. Y., Buffalo—Branch Bros., 83-95 Clyde Ave.—machinery for manufacturing metal products.

N. Y., Buffalo—Iroquois Door Co., 629 Exchange St.—woodworking machinery for proposed addition to mill.

N. Y., Buffalo—Lawler Iron Works, 18-20 Gull St.—equipment for foundry.

N. Y., Buffalo—Teachout Realty & Investment Co., 52 Leslie St.—machinery for planing mill.

N. Y., Buffalo—Whitmer, Jackson Co., Inc., 367 Hamburg St.—machinery for planing mill.

N. Y., New York—J. DeNigris & Co., Bryant and Oak Point Aves.—one rubbing bed lathe for stone yards.

O., Columbus—J. W. Coulson & Co., 95 West Spring St., J. H. Weiser, Gen. Mgr.—metal working machinery to equip new factory at 150 North 1st St.

Pa., Jersey Shore—School Dist., voted $35,000 bonds for equipment for vocational school.

Pa., Pittsburgh—Carnegie Steel Co., Carnegie Bldg., C. L. Miller, Purch. Agt.—motor driven drill press, 5 ft. radial drill, slotter for Edgar Thomson Works.

Pa., Pittsburgh—K. J. Hendricks, 425 4th Ave.—one 6 ft. cornice brake, 1 set 5 or 6 ft. forming rolls, 1 set sheet metal hand tools.

Pa., Uniontown—Ricks Foundry & Machine Co.—60 in. boring mill, bulldozer for handling 3½ in. x 36 in. x ½ in. material.

Va., Richmond—M. C. Thurston—punch, shear, eye bender and scarfing machines.

Wis., Baraboo—B. J. Kramer—woodworking machinery including band saw and planer.

Wis., Black River Falls—Jackson Box Co.—rip saws and band saws.

Wis., Milwaukee—Hevi-Duty Electric Co., c/o D. Van Dyke, 910 Wells Bldg.—presses and machinery to manufacture electric furnaces, etc.

Wis., Racine—J. Oster Mfg. Co., 3134 Osborn Ave., J. Oster, Purch. Agt.—die making machinery.

Wis., Waukesha—Quality Aluminum Casting Co., Lincoln Ave.—special casting machinery.

Wis., Wauwatosa—Super Steel Products Co., Hawley Rd. and State St., W. A. Belan, Purch. Agt.—sheet metal working machinery, including brake and rollers.

N. S., Windsor—Shaw Carriage Co.—complete general equipment for carriage manufacturing and repairs.

Ont., Chepstow—J. J. Donnelly, Walkerton—equipment for saw mill.

Ont., Elora—Walser Bros.—woodworking equipment for home furniture factory.

Ont., Hanover—A. G. Seim—miscellaneous tools and equipment for public garage.

Ont., Ottawa—The Poupore Lumber Co. Ltd., W. L. Scott, Purch. Agt.—complete equipment for saw mill.

Ont., Tottenham—McCabe Bros.—machinery for sash and door manufacturing.

Que., Montreal—Baldwin's Montreal Ltd.—equipment for iron and steel plant.

Opportunities for Future Business

Calif., Los Angeles — McEvoy Well Cleaner Co. & Standard Slotted Pipe Co., Higgins Bldg., had plans prepared for the construction of a 1 story, 60 x 160 ft. factory on West Slauson Ave. Private plans.

Calif., San Mateo—Gaffigan Sheet Metal Works, 8th Ave. and Main St., plans the construction of a shop at 9th Ave. and Main St. Estimated cost $5,000.

Conn., East Berlin — W. W. Mildrum Jewel Co. plans to rebuild plant destroyed by fire. Estimated cost $40,000. Architect not selected.

Conn., Hartford—Golden Storrs & Co., 983 Main St., Archts., are receiving bids for the construction of a 2 story garage at Goodman Pl. and Orchard St., for Katz Bros., 28 Orchard St. Estimated cost $150,000.

Mass., Chicopee—B. F. Perkins & Son, 1 Crescent St., Holyoke, manufacturers of paper & pulp machinery and electric disc fans, awarded the contract for the construction of a 4 story, 74 x 165 ft. factory on Chicopee St. Estimated cost $200,000.

Mo., Kansas City—Montgomery Ward & Co., St. John and Belmont Sts., awarded the contract for an 8 story, 108 x 206 ft. addition to plant. Estimated cost $1,000,000.

Mo., St. Louis—Peoples Motorbus Co., 585 Adelaide Ave., University City, is having plans prepared for the construction of a 1 and 2 story, 82 x 237 ft. garage and shop building. Estimated cost $100,000. Mauran, Russell & Crowell, Chemical Bldg., archts.

N. Y., Brooklyn—Saltser & Weinsier, 175 Cook St., manufacturers of plumbing supplies, awarded the contract for the construction of a 4 story, 90 x 175 ft. plant. Estimated cost $100,000.

N. Y., Brooklyn—Todd Ship Yards Corp., 25 Broadway, awarded the contract for the construction of a 1 story, 100 x 150 ft. machine shop at 134-24th St. Estimated cost $60,000.

N. Y., Buffalo—Teachout Realty & Investment Co., 52 Leslie St., has plans prepared for one additional story to planing mill. Estimated cost $10,000.

N. Y., Long Island City—International Harvester Motor Co., Grand Central Terminal, New York, awarded the contract for the construction of a plant at 13th and Hamilton Sts. Estimated cost $250,000.

N. Y., New York—Levine & Witkin, c/o M. Klein, 39 Graham Ave., Brooklyn, Archt. and Engr., is having plans prepared for the construction of a 2 story, 150 x 100 ft. garage on West 143rd St. Estimated cost $200,000.

O., Cleveland—Cleveland Twist Drill Co., J. D. Cox, Jr., East 49th St. and Lakeside Ave., had plans prepared for a 1, 2 and 4 story, 38 x 71 ft.-38 x 64 ft.-18 x 24 ft. and 18 x 38 ft. additions to factory. Estimated cost $40,000. G. S. Rider & Co., Century Bldg., Archts.

O., Cleveland—Novelty Lamp & Shade Co., 2490 E. 22nd St., awarded the contract for a 4 story, 60 x 80 ft. addition to factory at 2400 East 22nd St. Estimated cost $100,000. Noted Oct. 9.

O., Columbus—Columbus Heating & Ventilating Co., 425 West Town St., awarded the contract for the construction of a 2 story, 90 x 120 ft. factory.

Okla., Tulsa — Bradford Motor Works, Peoria Ave. at Santa Fe R.R., will build a 1 story, 50 x 100 ft. factory. Estimated cost $15,000. Sterling Engineering Co., 304 New Wright Bldg., Archt.

Pa., Philadelphia—Burt Mfg. Co., 1814 Ludlow Ave., manufacturer of ventilators, plans a 4 story, 32 x 72 ft. addition to factory at 9th and McKean Sts. Estimated cost $30,000. H. H. Kline, Bulletin Bldg., Archt.

Pa., Warren—Struthers Wells Co. (steel plate construction, riveted and welded), awarded the contract for a 1 story addition to plant. Estimated cost $60,000.

Tex., Dallas—Oliver & Myers Mfg. Co., Canton and Young St., H. E. Spalti, Pres., will soon receive bids for the construction of a furniture factory on Young St. Estimated cost $250,000.

Wash., Port Angeles—The Ninemire & Morgan Lumber Co., plans to rebuild plant recently destroyed by fire. Estimated cost $30,000.

Wis., Black River Falls—Jackson Box Co., is receiving bids for the construction of a 2 story, 42 x 70 ft. saw mill. Estimated cost $25,000. Private plans.

Wis., Oshkosh — Bell Machine Co., 35 Jackson St., E. Bell, Pres., awarded the contract for a 1 story, 36 x 100 ft. addition to factory. Estimated cost $40,000.

Wis., Racine—The Harvey Spring & Forging Co., is building a 100 x 144 ft. addition to its plant, to be equipped for heat-treating processes, doubling the capacity of the entire plant. Estimated cost $60,000 including equipment.

Wis., Two Rivers—Kahlenberg Bros. Co., manufacturers of marine and oil engines, plans a 2 story addition to plant. Architect not selected.

Wis., Waukesha — Quality Aluminum Casting Co., Lincoln Ave., awarded the contract for a 1 story, 102 x 150 ft. addition to factory.

Ont., Essex—Queen & Wigle, Talbot St., plans 45 x 150 ft. addition to garage and repair shops. Estimated cost $40,000.

Que., Montreal—Baldwin's Montreal Ltd., will soon receive bids for the construction of an iron and steel plant.

Que., St. David de Yamaska—Xavier Therronx & Freres, plans the construction of a 65 x 25 ft. sash and door factory, and combine mill. Estimated cost $30,000.